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REPORT

on the

FLOODS OF JUNE 1965

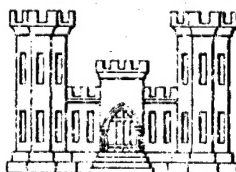
SOUTH PLATTE RIVER BASIN,

COLORADO AND NEBRASKA

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U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA
JANUARY 1967

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REPORT ON THE
FLOODS OF JUNE 1965
SOUTH PLATTE RIVER BASIN
COLORADO AND NEBRASKA

I. INTRODUCTION

1. AUTHORITY

This final report on the floods of June 1965 in the South Platte River basin in Colorado and Nebraska is made in compliance with paragraph 172.80 of EM 500-1-1. A flood emergency on the South Platte River and tributaries, Colorado and Nebraska, was declared on 17 June 1965 in accordance with the provisions of paragraph 161.30 of the Omaha District's Annex A, Emergency Flood Control Activities, to EM 500-1-1. Flood fighting and data collection activities were initiated under authorities contained in paragraphs 122.343, 122.345, 182.70 and 182.72 of EM 500-1-1. In addition, the post flood surveys and report were specifically authorized by the Chief of Engineers on 19 July 1965 by 2d Indorsement, ENGCW-OE (13 July 1965) to basic letter of 13 July 1965, subject: South Platte River Basin - Post Flood Report (MROGR-A).

2. PRIOR REPORTS

A previous report on the floods in the South Platte River basin in June 1965 was submitted to the Chief of Engineers on 10 August 1965 in response to a request from a subcommittee of the House Public Works Committee. The report was included in House Committee Print No. 15, 89th Congress, 1st Session, entitled: "The Colorado and Kansas Floods of June 1965 - Report of the Special Subcommittee to Inspect Flooded Areas in Colorado and Kansas to the Committee on Public Works, House of Representatives, June 1965".

3. PURPOSE

The purpose of this report is to supplement the previous report and to provide a more extensive record of the meteorological conditions of the flood producing storm, the hydrologic data of rainfall and flood discharges, the extent and magnitude of flooding, and the economic damages and social impact caused by the floods. It is intended that the report serve as a source of information on flooding characteristics and damage potentials for public officials and private interests.

4. SCOPE

a. The report provides brief descriptions of the physical and economic characteristics of the South Platte River basin to enable a fuller understanding of the patterns of flooding, and the extent and

character of flood damages. Principally, the report describes the flood-producing storm conditions, the rainfall patterns, the sequence and magnitude of flooding, the economic damages inflicted, and the operations of public bodies during the flood and post-flood recovery operations. Because of the vast areal extent of overbank flooding on the South Platte River and many of its tributaries, it was impractical to illustrate all areas of flooding on mapping at scales which serve useful purposes of record. For this reason, illustrations of overbank flooding are limited to Plum Creek, the South Platte River and Bijou Creek. The limits of overbank flooding of the South Platte River and Sand Creek at metropolitan Denver are recorded in detail in the report principally because of the larger economic impact of major flooding in metropolitan areas. Data on the flood control effects of Cherry Creek Reservoir are included to illustrate the importance and effectiveness of well-planned flood control improvements.

b. Because of widespread flooding which occurred in June 1965, and the tremendous economic damages inflicted, it was necessary to summarize damage estimates by major categories of damage and by principal locations. Thus, summaries are provided in the report by sub-basins, by major reaches of the South Platte River, and by urban locations. Flood damages have been summarized in the principal categories of urban, rural, and transportation damages. Urban flood damages have been summarized in the categories of residential, commercial and industrial, utilities, publicly-owned facilities, and miscellaneous categories. The miscellaneous categories include costs of flood fighting, policing, preservation of public health, clean-up and relief activities. Rural damages have been summarized in categories of farmsteads, livestock, cropland damage and crop losses, damages to irrigation works, and miscellaneous categories. The rural miscellaneous categories include items of damage similar to those of the urban category, but also include losses to power and telephone systems. Transportation damages have been summarized in the categories of urban streets and bridges, state highways and bridges, county roads and bridges, damages to railroad facilities and freight in transit, and the economic losses from traffic delays and detours.

c. In all summary categories, associated economic losses have been summarized with estimates of direct physical losses. However, special categories of miscellaneous secondary economic losses have been computed and summarized separately. These include the estimated loss of business resulting from the depressed volume of tourist trade because of the flood occurrence during the tourist season; the estimated loss of tax revenues because of casualty losses and reduced tax base; and the estimated additional economic burden on the regional economy imposed by the interest payments on disaster loans granted by the Small Business Administration.

d. The report also includes estimates of the flood damages resulting from the floods in July 1965, which affected some of the areas which had been flooded in June 1965, and which affected some tributary streams not materially affected by the June floods.

e. The report includes several maps to identify the basin streams and the streams on which flooding occurred. Selected photographs which illustrate typical flood scenes are included in the appendix to this report. All tables and plates are bound at the back of this report.

5. SOURCES OF INFORMATION

The following sources of information were used in compiling this report.

a. Meteorologic data.

(1) Vol. 70, No. 6, Climatological Data, June 1965, published by U. S. Weather Bureau.

(2) Field survey data ("bucket surveys") conducted by the Omaha District Corps of Engineers and Region 7, Bureau of Reclamation. Portions of this data were obtained from the Department of Weather Science, Colorado State University, for precipitation stations established and maintained by the University.

b. Hydrologic data. Hydrologic data on peak flood discharges at 44 stream locations in the South Platte River basin were obtained from the publication issued by the U. S. Geological Survey, Denver, entitled: "Floods of June 1965 in South Platte River Basin, Colorado and Nebraska - Preliminary Report of Peak Discharge, October 1965." Adjustments in data were based on information published in "Water Resources for Colorado - Part I, Surface Water Resources 1965," U. S. Geological Survey, Denver.

c. Flooding limits.

(1) Limits of flooding, established during and after the flood, were based on field surveys conducted by the Corps of Engineers with the assistance of Region 7, Bureau of Reclamation, together with survey data provided by the city of Denver and the city of Englewood, Colorado.

(2) Aerial photo coverage of flood areas was obtained through cooperative arrangements with Lowry Air Force Base photo laboratory, United States Air Force, Denver, Colorado; the Nebraska Department of Roads, and the Nebraska Air National Guard. A portion of the aerial photo coverage was obtained by contract with Continental Engineers, Inc., Denver, Colorado. Aerial photos were supplemented by ground photos taken by Corps of Engineers' personnel.

d. Flood damage estimates. Flood damage estimates were compiled from field survey data obtained by the Corps of Engineers, the Bureau of Reclamation and the Colorado Soil Conservation Service. These data were supplemented by estimates provided by State, municipal and county governments, and by inquiries to railroads, highway departments and industry. Correlation sampling was attempted for damages to commercial and industrial properties by using data reports of Dun and Bradstreet, Inc. This sampling was discontinued in favor of direct methods of data collection. Some adjustments in initial estimates were made on the basis of summary reports of damages and associated expenditures released to news media by official agencies. Information on Red Cross relief expenditures, Small Business Administration disaster relief loans, and in some instances reconstruction costs for roads and bridges were obtained from information released to news media. In some instances, data gaps were filled by reliance on stage-damage information compiled in pre-flood investigations. Associated economic losses were computed on the basis of similar losses compiled from the analysis of post-flood data collected on previous floods in the Missouri River basin.

II. DESCRIPTION OF THE BASIN

6. PURPOSES OF BASIN DESCRIPTIONS

The descriptions of the physical and economic characteristics of the South Platte River basin provided in this section are intended to convey an understanding of the location and size of the South Platte River basin, the relationship of streams in flood to the economic developments of the basin, and the effects of floods on the urban economy, the rural economy, and the transportation facilities of the region. Climatic characteristics are discussed to identify the semi-arid nature of the region and the consequent reliance on elaborate water supply systems and irrigation systems to sustain the urban and rural economies. Population concentrations are discussed to identify the impact of floods on the more populous urban and stream valley areas. The scenic attractions of the mountainous portions of the basin and the Rocky Mountain range are discussed to identify the impact on the basin economy from losses in tourist trade because of major floods.

7. LOCATION

The South Platte River basin is located within the Missouri River region and within the States of Colorado, Nebraska and Wyoming. It is bounded on the west by the Continental Divide and the Rocky Mountain range, on the north by the North Platte River basin, on the east by the Platte River basin, on the southeast by the Republican River basin, and on the south by the Arkansas River basin. A general map of the basin is provided on plate 1.

8. DRAINAGE AREAS

The South Platte River watershed drains 24,300 square miles, of which 19,450 square miles lie in Colorado, 2,050 square miles lie in southeastern Wyoming, and 2,800 square miles lie in southwestern Nebraska. A tabulation of drainage areas at selected locations in the basin is provided in table 1. A tabulation of stream lengths is given in table 2.

9. PHYSIOGRAPHIC FEATURES

Approximately 23 percent of the drainage area is high mountainous terrain in the Rocky Mountain range. The mountainous regions lie on the western portions of the basin. Toward the northeast and east, the basin's features change from the rougher, steeply sloping terrain of the high plains region to the broadly terraced plains lands of the lower basin. The stream valleys begin as narrow valleys and canyons in the mountainous regions and increase progressively in width toward the lower regions of tributary streams. The valley of the South Platte River begins to broaden at metropolitan Denver and increases progressively in width from Denver to its mouth near North Platte, Nebraska. Basin elevations range from 14,200 feet m.s.l. at the Continental Divide to approximately 2,800 feet m.s.l. at the mouth.

10. STREAM FLOW

The U. S. Geological Survey in cooperation with the Colorado State Engineer's office has maintained stream gaging stations in the South Platte River basin since 1895. Comparative peak discharges for the June 1965 flood and previous recorded maximums are given for selected locations in table 3.

11. ECONOMIC CHARACTERISTICS

a. Population. In 1960, the estimated population of the South Platte River basin was 1,184,000 persons, of which about 78 percent resided in metropolitan Denver. In 1960, the basin's population density averaged 48.7 persons per square mile. However, population densities are concentrated principally in the upper portions of the basin (average population density of 61.5 persons per square mile) and primarily in the Denver metropolitan region. In 1964, the population density within the Denver metropolitan region averaged 5,108 persons per square mile, while within the 88 square mile area of the city of Denver, the population density was 5,950 persons per square mile. The principal community development areas of the Denver metropolitan region which are situated adjacent to the South Platte River are: Columbine, Littleton, Englewood, Sheridan-Centennial, Denver, Commerce City and Brighton. The communities in the Sand and Toll Gate Creek basins (metropolitan Denver) are Aurora and Commerce City.

b. Urban areas.

(1) The thirty communities which experienced flooding in June 1965 had a total population (1960) in excess of 999,433. These communities ranged in size from metropolitan Denver (population 929,383) to three towns of less than 100 persons each. Outside of metropolitan Denver, the largest communities which experienced flooding were Greeley, Colorado (population 26,314) and Sterling, Colorado (population 10,751).

(2) Metropolitan economy. Metropolitan Denver ranks as the twenty-fifth largest metropolitan area in the United States among the fifty-five metropolitan areas with populations of 500,000 or over. It serves as the marketing and distribution center of the Rocky Mountain area, and the commercial, financial, manufacturing, professional and cultural hub of this vast region. Its leading industries by order of rank are manufacturing, retail trade, wholesale trade, public utilities, service industries, construction finance, and mining. In 1960, the number of persons employed in the Denver metropolitan area was 353,823.

c. Rural areas. The South Platte River basin contains approximately 15.5 million acres of land and water, 12.7 million acres are in farms and ranches of which 980,000 acres are irrigated and 11,720,000 acres are non-irrigated. Livestock and livestock products make up 48 percent of the value of all farm products produced in the basin. Field crops produce 39 percent of the value of farm production and the remaining 13 percent of production value results from dairy operations, poultry, and fruit and truck crops. The major field crops produced are winter wheat, alfalfa, corn, barley, sugar beets, field beans, hay forage sorghum, grain sorghum, oats, potatoes, rye, and spring wheat. Irrigation provides the stable economic base for the rural economy of the basin. Irrigation systems have been developed from surface water and groundwater resources. Groundwater irrigation was developed initially in the 1930's and principally after World War II. The surface water supply averages approximately 1.4 million acre-feet annually, of which about 14 percent is imported by transmountain diversion. Seventy-two diversion systems divert irrigation water from the main stem of the South Platte River. There are approximately 360,000 acres under irrigation in the South Platte River valley, about 242,000 acres in the Cache LaPoudre River valley, and 90,000 acres in the Big Thompson River valley. The Lodgepole Creek, Crow Creek and Beaver and Badger Creek valleys combined have about 46,000 acres under irrigation, of which over 75 percent is irrigated from groundwater wells. In addition to metropolitan Denver, the principal towns situated in the valley of the South Platte River are Fort Lupton, Greeley, Brush, Sterling, Julesburg in Colorado, and Ogallala and North Platte in Nebraska.

d. Transportation facilities.

(1) Highways. Three interstate highways, seven U. S. highways, and thirty-six State highways traverse the South Platte River basin. Traffic densities on the interstate routes range from 12,000 to 50,600 vehicles daily.

(2) Railroads. The basin is served by six railroads. The Union Pacific; Chicago, Burlington and Quincy; Chicago, Rock Island and Pacific Railroads traverse the basin along east-west routes. The Atchison, Topeka and Santa Fe; Denver, Rio Grande and Western; and the Colorado and Southern Railroads cross the basin along north-south routes. All of the railroad routes converge on Denver, Colorado.

e. Tourism. Colorado's high mountains and incomparable scenic beauties, vast forests, numerous fishing and boating waters, and winter sport areas make the state a year-around vacation land for millions of visitors annually. In 1964 more than 6 million visitors spent an estimated \$505 million in the State of Colorado. The number of visitors of all vacation categories increased about 30 percent from 1960 to 1964 and their spending increased about 29 percent. Tourism is ranked fourth of five major industries considered to be basic or growth-producing in Colorado's economy.

12. CLIMATE

The climate of the basin varies with its physiographic features of mountains, foothills, and plains. Generally, the mountain regions have the most rigorous climate and the greatest annual precipitation - except for the areas surrounded by high mountains. The mountain region precipitation - near the Continental Divide - exceeds 50 inches annually. The foothills region has a climate more moderate than either the mountain or plains regions. Precipitation in the foothills region averages between 15 and 20 inches annually. The climate of the plains region is characterized by cold winters, hot summers, light rainfall, low humidity and considerable wind. The average annual precipitation in the plains region is about 15 inches, with variations of from 12 to 19 inches. The most pronounced climatic characteristic of the basin is the periodic storm activity which historically has produced high intensity rainfall, with rainfall depths within a few hours frequently equivalent to a major portion of the average annual rainfall.

13. FLOOD CHARACTERISTICS

The flood characteristics of the basin also vary with the physiographic features of the regions. In the mountain regions, floods result from rapid snowmelt or sudden intense rainfall. The rainstorm floods are characterized by rapid concentrations of runoff which result in sudden rises in stream stages, and produce the high

velocity flash floods which are particularly hazardous to life and property. The foothills regions have flash floods similar to the mountain regions, but generally reflect a greater hazard because dry washes become raging torrents with high velocities that erode the normal boundaries of stream flow. As the foothills streams converge to form the main tributaries and tributary streams converge on the main stream, the valleys and flood plains become broader. The broader valleys and flatter stream slopes reduce the discharge rate of the flood by combinations of temporary overbank storage and lower energy gradients. The lower velocities increase the duration of flooding and permit the sediment load and debris load carried from upstream areas to be deposited on the more productive lands of the lower valleys. Consequently, the damaging effects in the lower valleys are a combination of destruction by erosion and inundation with reduction in the productive quality of valley lands by flood debris and sediment. The damaging effects of floods are also governed significantly by the nature of storm patterns and tributary runoff. Rainfall concentrated over one tributary watershed generally limits the destructiveness of floods to the tributary stream affected. However, the runoff from larger storm patterns results in flood discharges on many tributaries which converge on the main stream, thereby causing more widespread destruction, prolonged inundation, and greater flood damages over larger areas.

III. EXISTING IMPROVEMENTS

14. FEDERAL IMPROVEMENTS

a. Corps of Engineers.

(1) The Cherry Creek Dam and Reservoir on Cherry Creek was completed in 1953 at a cost of \$14.7 million. It is situated approximately 11.5 miles above the mouth of the stream at central Denver. It controls 385 square miles of the 409 square mile Cherry Creek watershed. The dam is a rolled earth fill structure, with a reservoir storage capacity to the crest of the emergency spillway of 96,000 acre-feet. This storage capacity consists of 81,000 acre-feet for flood control storage and 15,000 acre-feet for conservation storage. The conservation pool also serves the project's recreation function.

(2) The Kelly Road Detention Dam is a small capacity (380 acre-feet) flood detention project on Westerly Creek situated near the Lowry Air Force Base at Denver, Colorado. It provides flood protection for portions of Aurora and Denver, Colorado. It was completed by the Corps of Engineers in 1954 at a cost of \$227,000.

b. Soil Conservation Service. The Soil Conservation Service has constructed three watershed projects in the South Platte River basin which include a total of 106 floodwater retarding structures. The

Kiowa Creek project is one of the original pilot watershed projects constructed by the Soil Conservation Service in the United States. The project consists of 65 floodwater retention structures located within the 118 square mile drainage area. Two other watershed projects have been constructed in the upper portions of the Cherry Creek basin. The West Cherry Creek project consists of 16 floodwater retention structures in a watershed area of 49 square miles, and the Franktown-Parker project consists of 25 floodwater retention structures in a watershed area of 276 square miles.

c. Bureau of Reclamation. The Bureau of Reclamation has constructed no improvements in the portions of the South Platte River basin affected by the June 1965 floods. The Bureau of Reclamation's Colorado-Big Thompson transmountain diversion project imports water from the Colorado River basin on the western slope of the Rocky Mountains to the Big Thompson River basin, a tributary of the South Platte River basin. The project provides water for irrigation and municipal use.

d. Englewood Dam. Englewood Dam was constructed as a WPA project during the 1930's. It is located on Little Dry Creek approximately 9 channel miles upstream from Englewood, Colorado. The project serves as a flood detention dam for control of about 11 square miles of the 27 square mile drainage area of the Little Dry Creek basin. Storage capacity is approximately 1,485 acre-feet at spillway crest. The project suffers from inadequate maintenance because of disputed ownership of project lands.

15. NON-FEDERAL IMPROVEMENTS

a. South Platte River at Denver. In 1921, the city of Denver constructed channel improvements on about 11.5 miles of the South Platte River at Denver. The discharge capacity of this improved reach of channel ranges from approximately 9,500 cubic feet per second to 29,000 cubic feet per second. The perched condition of the channel limits the effective capacity of the channel to 9,500 cubic feet per second.

b. Cherry Creek at Denver. Approximately 7.7 miles of improved channel on Cherry Creek at Denver were constructed in the 1920's by the city of Denver. The original design capacity was 10,000 cubic feet per second. The present effective capacity is approximately 4,700 cubic feet per second. However, concrete flood walls which are part of the channel improvement have been undermined by erosion in many locations; for this reason, high discharges could cause collapse of the flood walls.

IV. DESCRIPTION OF THE FLOODS OF JUNE 1965

16. METEOROLOGY

During the period of 15-18 June 1965, a quasi-stationary front was oriented on a north-south line along the mountains in southern Wyoming, Colorado, and northern New Mexico. On 14 June, a closed circulation formed aloft over the California-Nevada area and continued to deepen, thereby causing southerly winds over Colorado. This upper air low, coupled with a ridge over the Great Plains region, produced an atmospheric circulation that transported a deep layer of moist air northward from the Gulf of Mexico to the plains east of the Rocky Mountains. At the same time, a series of squall lines formed and moved rapidly eastward from the quasi-stationary front, triggering intense precipitation in various locations east of the mountains. The surface dewpoint temperatures during this period were generally in the upper 50's. On 18-19 June the upper air low began dissipating, allowing the upper-air wind circulation to return to a more westerly direction over Colorado. The quasi-stationary front then began to move eastward out of the flood area as a cold front.

17. DEPTH-AREA-DURATION VALUES

The rainfall isohyetal map of the storm, plate 2, and the rainfall depth-area curves, plate 3, illustrate that the storm of 16-17 June 1965 ranks with the major storms for this general area. The isohyetal map and pertinent depth-area values were derived from the regular Weather Bureau precipitation station records for this area, and from "bucket survey" data obtained shortly after the storm by survey teams from the Corps of Engineers and the Bureau of Reclamation. Plate 4 illustrates the 6-hour storm depth-area amounts on 16 and 17 June for the portion of the storm in the Denver-Colorado Springs area and, for comparison, the 6-hour probable maximum storm values and the 6-hour values for the 30-31 May 1935 storm. Relative storm magnitudes are self-evident.

18. STORM PATTERNS

Antecedent rainfall prior to the principal storm was moderate and spotty. The floods which occurred in the South Platte River basin during the period 14-22 June 1965, resulted from heavy to torrential rainfall over large portions of the South Platte River basin. Heavy rainfall occurred over portions of the northern sections of the South Platte River basin on the 14th and 15th of June. As the storm system moved southward, torrential rainfall centered principally over the Plum Creek and Bijou Creek watersheds on 16 June. Storm rainfall on 16 June extended over some 3,000 square miles of the South Platte River basin, including the Plum Creek, Cherry Creek, and Sand and Toll Gate Creek watersheds in the Denver region, and the Kiowa Creek, Commanche Creek, Badger Creek, and Beaver Creek watersheds to the east.

19. RAINFALL

a. During the afternoon of 16 June, unprecedented amounts of rain (estimated up to 14 inches in a few hours at Larkspur, Colorado and 10 inches near Castle Rock, Colorado) fell on the drainage areas of East and West Plum Creeks in the foothills of the Palmer Lake area. The average 6-hour rainfall over 1,000 square miles was 4.8 inches. Again, on the 17th of June, heavy rains occurred across eastern Colorado. A series of 12- to 14-inch centers were reported in the Falcon, Peyton, and Fords, Colorado area northeast of Colorado Springs. The average 6-hour rainfall over 1,000 square miles was 7.8 inches. Other centers with total rainfall values of 18 inches or more during this period were reported near Two Buttes, and Holly, Colorado.

b. Unsettled weather continued until 26 July 1965, with repeated rainfall and runoff in areas of earlier flooding. During the period 23 to 26 July, the storm pattern also extended over the foothills areas of the Bear Creek and Clear Creek watersheds.

20. PATTERNS OF FLOODING

a. On the 14th and 15th of June, flood stages on tributary streams in the northern portions of the South Platte River basin closed roads and damaged private property in low-lying areas. The principal streams in flood stage in the lower South Platte River basin were Lone Tree Creek, Crow Creek, Pawnee Creek in Colorado, and Lodgepole Creek in Nebraska. Tornado damage and runoff from smaller contributory drainage areas made it difficult to determine the sources and causes of damages in some areas.

b. On the afternoon of the 16th of June, storm runoff caused unprecedented discharges and extensive damages along East and West Plum Creeks which combined to cause record flood stages on lower Plum Creek. The flood entered the South Platte River south of Denver at approximately 7 p.m. on the 16th. It destroyed or damaged everything in its path through the 44-mile reach of metropolitan Denver before spreading out into the agricultural flood plain north and east of Denver. While the Plum Creek flood passed through Denver, heavy runoff from the upper Cherry Creek watershed caused considerable damage above Cherry Creek Reservoir, but additional damage to Denver was prevented when the reservoir impounded the entire flood volume. Because the storm pattern extended over the Sand and Toll Gate Creek watersheds, heavy runoff from these streams destroyed bridges and track facilities in the vicinity of Aurora, Colorado, and contributed additional flood volume to the South Platte River just north of Denver proper. As the flood passed downstream, heavy runoff from the Cache LaPoudre River and the Big Thompson River contributed their volume to upstream discharges attenuated by valley storage.

c. East of metropolitan Denver, the storm pattern extended over Kiowa, Commanche, Bijou, Beaver, and Badger Creeks. The storm which occurred over Bijou Creek and adjacent watersheds centered principally over the upper Bijou Creek basin. The resultant flooding exceeded all previous records in area flooded, peak discharges, and flood damages. Interstate highway and other major highway bridges were destroyed. The business sections of the towns of Byers and Deer Trail were almost completely destroyed. The peak discharge of the Bijou Creek flood, estimated at an unprecedented 466,000 cubic feet per second, entered the South Platte River just above Fort Morgan, Colorado, and caused extensive flooding and damage as far as the junction with the Platte River some 190 miles downstream. Overall, the floods during the period 14 June through 22 June, inundated an estimated 252,925 acres along 1,200 stream miles under flood. The basin streams in flood, and a schematic diagram of peak discharges, are illustrated on plates 5 and 6, respectively. General flood outlines of the South Platte River and its tributaries, and high water marks for the metropolitan reaches on the South Platte River and Sand and Toll Gate Creeks are included in the appendix to this report. Photos of selected flood scenes also are included in the appendix.

d. Thirteen lives were lost in the South Platte River basin, including four on Plum Creek, three on the Cache LaPoudre River, two on Bijou Creek, two on Beaver Creek, and one each on Cherry Creek and the Big Thompson River.

21. FLOOD DAMAGES PREVENTED

a. General. Federal flood control improvements located in the South Platte River basin in the areas of the June 1965 flood runoff include the Corps of Engineers' Cherry Creek Dam on Cherry Creek and the Soil Conservation Service's watershed projects in the upper Cherry Creek basin and the Kiowa Creek basin.

b. Cherry Creek Dam and Reservoir.

(1) During the evening and night of 16 June 1965, the Cherry Creek Reservoir impounded a flood which had a peak inflow of 58,000 cubic feet per second and a volume of 16,000 acre-feet. The peak discharge entered the reservoir at 7:30 p.m. on 16 June. Had the dam not been constructed, this discharge would have continued downstream, overflowing approximately 12 miles of Cherry Creek channel through a heavily developed area of Denver. Moreover, this flood would have joined the flood on the South Platte River which had originated on Plum Creek, and would have raised flood stages upstream and downstream of the confluence of Cherry Creek. The flood originating on Plum Creek caused a peak discharge in the South Platte River at the Denver gage of 40,300 cubic feet per second. The combination of this

flood with the runoff from Cherry Creek would have resulted in an estimated peak discharge at the Denver gage of 65,000 cubic feet per second.

(2) Had the flood occurred on the lower Cherry Creek channel, it would have carried away the 41 structures which cross the stream in the urban reach. These include six railroad bridges, 28 major city bridges, one pipeline and six foot bridges. Moreover, the higher flood stages on the South Platte River would have damaged or destroyed the remaining bridges over the river which were not destroyed by the South Platte River flood. The additional flood volume also would have increased flood stages considerably in the rural reaches downstream from Denver, and would have caused additional major damages to irrigation structures, irrigated lands, and roads and bridges in these reaches. However, the major damages would have been inflicted on the commercial and industrial properties along the Cherry Creek channel and the lower South Platte River valley in metropolitan Denver. The increased stages near the confluence of Cherry Creek and the South Platte River would have flooded vastly greater areas of central Denver and would have virtually paralyzed the metropolitan community. In addition to preventing much greater flood damages, Cherry Creek Dam retained a large volume of flood-borne debris which otherwise would have considerably increased the cost of cleanup operations in metropolitan Denver. Flood damages prevented by the Cherry Creek project are estimated at \$130 million. The inflow hydrograph at Cherry Creek Reservoir for the 16 June flood is illustrated on plate 7.

(3) During the period 23-26 July 1965, the Cherry Creek project impounded three separate surges of additional flood runoff. The largest of these had a peak inflow of 5,000 cubic feet per second. The total flood volume impounded during this period was 3,144 acre-feet. Since the June flood would have destroyed the economic improvements of the Cherry Creek valley, the theoretical damages prevented in the July flood were not computed nor have estimates been made of the losses to reconstruction which would have been in progress.

c. Soil Conservation Service watershed projects.

(1) Kiowa Creek watershed project. Of 60 floodwater retarding structures constructed in the Kiowa Creek basin, 30 were filled to capacity by runoff from the June 1965 flood. Water flowed over emergency spillways to depths of as much as 35 feet. These structures prevented flooding of an additional 2,500 to 3,000 acres. In addition, the project prevented severe flooding in the towns of Elbert and Kiowa as well as damage or loss of State and county bridges. This project is credited with estimated damage prevention of \$700,000 at an invested cost of \$1,250,000.

(2) Franktown-Parker watershed project - upper Cherry Creek basin. Eighteen small dams constructed by the Soil Conservation Service in the Franktown-Parker area of upper Cherry Creek basin reduced flood flows upstream of the Cherry Creek Dam. Of three structures filled during the flood, two were overtopped and sustained erosion damage, but the third structure functioned satisfactorily. The remaining 15 structures were outside the area of high intensity rainfall and received only moderate runoff. Benefits attributable to the system include reduction of damages to county roads, land and buildings, and irrigation systems. These benefits are estimated at \$150,000.

(3) West Cherry Creek watershed project. The West Cherry Creek watershed contains 16 floodwater retarding structures. The project area was on the fringe of the storm rainfall, with rainfall values of 1 inch and less. The Soil Conservation Service's report did not attribute any flood damage prevention to this watershed project.

d. Non-Federal flood control improvements.

(1) The capacity of the improved channel of the South Platte River at Denver was greatly exceeded by the flood discharge on 16 June, consequently, no flood damage prevention was assigned to these improvements.

(2) The privately constructed agricultural levee system on the South Platte River immediately downstream of Denver was overtopped and flanked by the June floods and was unable to prevent flooding from the lesser floods of July and August. Consequently, no prevention of flood damages was credited to these improvements.

V. DISASTER PREPARATION AND ACTION

22. ACTION BY THE CORPS OF ENGINEERS

a. Pre-flood and post-flood operations performed by the Corps of Engineers were undertaken in compliance with the authority provided in Public Law 99, 84th Congress. Operations under this authority included pre-flood surveillance of developing storm and runoff conditions; reconnaissance and surveillance of flooding, flood crest movements, flood damages; cooperative activities with other Federal, State, and local agencies, and certain clean-up and restoration of flood-damaged public facilities. A major aspect of Corps of Engineers activities involved cooperative operations with the Office of Emergency Planning in compiling estimates of flood damages and cost estimates for certain aspects of post-flood recovery work performed by local government under the provisions of Public Law 875.

b. The Corps of Engineers Resident Engineer in Denver began surveillance of the storm and flood conditions on 14 June 1965 when

heavy rainfall and stream overflow began in the northern portions of the basin. The information on prevailing conditions was transmitted by telephone to the District Engineer at Omaha, Nebraska. The District Engineer transmitted periodic flood-situation reports to the Chief of Engineers in Washington, D. C., and the Division Engineer, Missouri River Division.

c. On the afternoon of 16 June, on the basis of reports of heavy rainfall in the Plum Creek basin, the District Engineer mobilized flood emergency teams. An advance support party arrived in Denver by first available air transportation at 4:30 p.m. on 17 June. Initial activities of the advance party included air and surface reconnaissance of flooded areas, preparation of damage estimates, exchange of information with State officials and officials of the Office of Emergency Planning, and organizing for emergency operations. Shortly thereafter, the Omaha District Engineer and additional engineering personnel arrived in Denver. Meetings were held with the Governor of Colorado and officials of the Office of Emergency Planning. The flooded areas were declared a major disaster area by the President of the United States under the authority provided by Public Law 81-875. Meanwhile, the Governor of Colorado and the Office of Emergency Planning had established a concerted plan of action to preserve public health and safety, to restore essential public facilities, and to initiate disaster recovery operations. All available facilities of the Federal, State, county, and local governments were mobilized to provide immediate relief and assistance, and to promote recovery of the flood-damaged areas. The Office of Emergency Planning requested the Corps of Engineers to assemble cost estimates of flood-fighting operations, removal of debris from public property, restoration of essential water supply and sanitary facilities, and the cost of sanitary measures necessary for prevention of epidemics and preservation of public health.

d. Under the authority of Public Law 99, the Corps of Engineers also undertook reconnaissance of the flood threat to downstream areas and began collection of hydrologic and flood damage data. The Corps of Engineers also advised local communities on emergency measures to avert further damages from continuing high stream stages. Subsequently, the Corps of Engineers contracted for removal of the large volume of flood-borne debris which had been deposited in Cherry Creek Reservoir, and provided inspection services for recovery operations authorized by the Office of Emergency Planning for restoration of essential public facilities. Thirty-five engineers and engineering technicians from the Corps of Engineers, Omaha District office, were engaged in the field in disaster-relief activities and collection of flood data. Twenty additional persons provided supporting services. The expenditures incurred by the Omaha District are summarized in table 4.

Table 4
CORPS OF ENGINEERS EXPENDITURES FOR
RECOVERY AND RESTORATION OPERATIONS
JUNE-JULY FLOODS 1965
SOUTH PLATTE RIVER BASIN

Debris removal, Cherry Creek Reservoir	\$ 78,100
Levee repair, South Platte River, Adams & Weld Counties, Colorado	53,600
Engineering services for Office of Emergency Planning ⁽¹⁾	<u>34,300</u>
TOTAL	\$166,000

(1) Cost estimates, and supervision and inspection of work performed in categories of flood fighting, debris removal, restoration of essential water supply and sanitary facilities, and emergency public health measures.

e. Shortly after the floods, the Office of Emergency Planning requested the Corps of Engineers to compile estimates of the costs to local governments for flood fighting, debris removal, preservation of public health and restoration of minimum facilities for water supply and sanitation. The estimated cost for these operations totaled \$1,341,000 for the South Platte River basin. The Corps of Engineers also supervised and inspected restoration work, principally debris removal from public property in the South Platte River basin, at a cost of \$274,900.

23. OPERATIONS OF OTHER FEDERAL AGENCIES

a. General. Federal agencies other than the Corps of Engineers also were involved in emergency operations and collection of data. The operations of the Office of Emergency Planning and the Corps of Engineers were supported by aircraft provided by the Army at Fort Carson. Photo units at Lowry Air Force Base provided aerial photography of flooded areas. The following subparagraphs briefly describe the activities of participating agencies.

b. Office of Emergency Planning. Immediately after the flood, the Office of Emergency Planning undertook coordination of data collection for defining the scope of the flood disaster and to provide assistance to states, counties and municipalities under the provisions of P.L. 875.

c. Bureau of Reclamation. The Bureau of Reclamation compiled data on damages to irrigation works and assisted the Corps of Engineers in collecting hydrologic data and flood outline information.

d. Soil Conservation Service. The Soil Conservation Service compiled damage data for agricultural lands and rural areas.

e. Geological Survey. The United States Geological Survey compiled data of peak flood discharges throughout the South Platte River basin.

f. Weather Bureau. The United States Weather Bureau compiled storm rainfall data from its regular reporting network.

g. Other agencies. The Small Business Administration provided public information on loan procedures for repair and restoration of flood-damaged property and provided flood disaster loans. The Federal Housing Administration, the Veterans Administration and the Farmers Home Administration provided public information on loan and refinancing procedures under their respective authorities. The Federal Bureau of Public Roads assisted in collecting data on damage to roads and bridges and provided assistance in restoration of transportation facilities.

24. OPERATIONS OF NON-FEDERAL AGENCIES

a. State of Colorado. The Governor of Colorado assumed active leadership in coordinating State and Federal measures to alleviate suffering and restore essential public services. The Colorado National Guard was used to help evacuate persons stranded by flood waters, to patrol flood damaged areas, and to protect flooded areas against looters. State and local departments of public health issued warnings of water supply contamination and instructions for purifying suspected water supplies. These departments also provided inoculation against typhoid and tetanus, and publicized measures for disposing of dead animals and preventing outbreaks of mosquito and rodent disease vectors. The State Engineer provided information on flood discharges and cooperated in collecting hydrologic data.

b. Metropolitan Denver. The fire and police departments of the municipalities of metropolitan Denver and County Sheriffs provided initial warnings to residents of flood hazard areas and assisted in the evacuation of people. Particularly in metropolitan Denver, the efforts of police and fire departments in evacuating residents from the path of the flood are credited with preventing loss of human lives in metropolitan Denver. After the flood had crested, fire and police departments, with the aid of auxiliary forces, spent endless hours fighting fires, barricading hazardous areas, unsnarling monumental traffic tie-ups, and providing protection against the hazards of downed power lines and escaping gases.

c. Local actions. In other areas of the basin, local authorities prevented additional flood damages by erecting emergency levees. At Sterling, Colorado, local officials erected an emergency dike on the

railroad tracks to keep flood waters from entering a large portion of the city's residential area. Moreover, advance warning of the arrival of the flood crest at Sterling permitted evacuation of approximately 50,000 head of cattle from feed lots located in the path of the flood. Similarly, greater flood losses were prevented at other urban locations along the lower South Platte River by timely warnings which permitted erection of temporary protection or evacuation of flood hazard areas.

VI. FLOOD DAMAGES

25. COLLECTION OF FLOOD DAMAGE ESTIMATES

a. The estimated flood damages presented in this report represent the effects of major flooding along 1,200 miles of streams in the South Platte River basin which inundated approximately 253,000 acres of agricultural lands and which directly affected 30 cities or towns in the basin having a population totaling over one million persons. The flood damages inflicted reflect the effects of flood discharges as high as 466,000 cubic feet per second on the normally dry Bijou Creek and 154,000 cubic feet per second on Plum Creek upstream from metropolitan Denver. Plum Creek, during the previous 17 years of gaging record, had a maximum discharge of 3,800 cubic feet per second and on numerous occasions recorded no flow. The maximum discharge on Plum Creek in 1964 was 290 cubic feet per second. The flood damage estimates include the direct costs and damages and the associated economic effects resulting from physical destruction and damages. Direct costs also include the cost of flood fighting and post-flood efforts, of policing, patrolling, alleviation of human suffering, and preservation of public health.

b. No estimates have been made of the extra man-hours of work required because of the flood, nor of the lost productivity caused by work interruptions, traffic delays, and extra hours required to perform normal activities. Such items as troops exceeding battalion strength assigned to patrol flooded areas in metropolitan Denver, 1,000 extra men put to work on initial clean-up of flooded areas, the use of C-119 Flying Boxcars to ferry emergency supplies to the stricken area, and Red Cross relief expenditures of almost \$900,000 for immediate relief of over 1,400 families or individuals in Denver alone can only hint at the total amount of related flood costs. In an effort to prevent outbreaks of encephalitis, \$300,000 was spent to spray more than 194,000 acres of flooded land, nevertheless, numerous cases were reported. Many communities had to rely on bottled water supplies, and the loss of utilities resulted in widespread and prolonged disruption of normal activities. The destruction or damage to major traffic arteries in metropolitan Denver and throughout the basin caused severe disruptions of normal traffic movement and commerce. Moreover, the disruptive effects of the initial damage and destruction of bridges, highways, and streets were compounded by repeated flooding in July and by damage to the temporary crossings constructed after the June floods.

c. The estimates of flood damages which occurred in the South Platte River basin were collected from a number of sources. It was characteristic of most sources of information that initial estimates were revised upward after the scope of damages became more evident. The estimates summarized in this report used data obtained from the Soil Conservation Service, the Bureau of Reclamation, the Colorado Highway Department, railroads and utilities, and the affected cities and towns. Flood damage estimates also were compiled and correlated by field surveys, by analysis of aerial photographs, and by office studies of discharge damage relationships derived from previous flood control studies in the basin. The losses resulting from traffic delays and detours were estimated from previously collected traffic density data. Associated economic losses were estimated by applying loss factors to estimates of direct physical damages. These loss factors had been previously developed from analyses of flood damage histories throughout the Missouri River basin.

26. EVALUATION OF URBAN DAMAGES

a. Denver metropolitan area. Estimates of flood damages in the Denver metropolitan area were compiled from post-flood surveys. These surveys included field observations, interviews with affected property owners, surveys of damage to public facilities compiled for the Office of Emergency Planning, and information acquired from local public officials and other sources. The information acquired from these sources was correlated and amplified by means of data assembled during previous flood control studies in the basin. Finally, because of the extensive damages inherent in a flood of disaster magnitude, the damage experience of other major floods in metropolitan areas of the Missouri River basin was used to further correlate damage estimates. Previous damage experience also was used to augment incomplete estimates of associated economic losses and categories of primary damages not readily susceptible to direct estimates, such as cargo in transit losses, freight delays, and re-routing. To the extent that flood damage data was subsequently available, initial estimates of damages were repeatedly revised on the basis of new data and additional information. Nevertheless, it is recognized that the magnitude of physical damages inflicted and the varied economic losses associated with major urban floods precludes adequate documentation of estimates in all categories of flood damage. However, the methods used to compile and correlate damage estimates are considered to have achieved a reasonable estimate of total damages.

b. Other urban areas. The damage estimates of urban areas outside the Denver metropolitan area were compiled from a combination of field surveys, information from other public and private sources, and from pre-flood control investigation data.

27. EVALUATION OF RURAL DAMAGES

a. Rural flood damage estimates were based on information acquired through field surveys, combined with or augmented by data compiled by the United States Bureau of Reclamation and the United States Soil Conservation Service. In many areas of the basin, post-flood survey data were correlated with data on flood damage potentials developed in previous flood control investigations. These latter data were used to estimate damages attributable to loss of crop production outside the flooded areas due to loss of irrigation water supplies. It is recognized that the extra moisture prevalent in these areas during June and July of 1965 would tend to offset losses from impaired delivery of irrigation water. However, the drought conditions of the 1966 season in the affected region indicate that crop losses associated with impaired storage capability may far exceed the compensation from extra direct rainfall moisture which was available during June and July of 1965.

b. The estimates of rural losses include farmstead damages, crop losses, damages to irrigation works and related loss of crop production. Losses to the electrical distribution systems and telephone systems, and such flood-related expenditures for debris removal, dead livestock disposal, measures to preserve public health, and flood-fighting activities have been tabulated in summaries of rural damages as miscellaneous items. The estimates of rural damages include associated economic losses, the factors for which were computed during flood control investigations. These associated economic losses reflect the estimated reductions in rural economic activity associated with losses in agricultural production.

28. EVALUATION OF TRANSPORTATION DAMAGES

The category of transportation damages includes physical damages to city streets and bridges, State and Federal highways, roads and bridges, and county roads and bridges. The category also includes estimates of physical damages to railroads, trucking, freight cargo, and the associated economic losses resulting from delays in freight deliveries, traffic re-routings, and other factors. The associated economic losses attributed to damage and destruction of highway roads and bridges were estimated in terms of traffic detours and delays. Estimates were made by the Corps of Engineers of physical damages to bridges, roads, and railroads, and of replacement and repair costs. These estimates were correlated with estimates compiled by the State Highway Department, county highway departments, and municipal departments of public works. The losses resulting from traffic delays and detours were estimated from standard vehicle charges, traffic density patterns, and estimates of duration of bridge and road outages. Physical damages to railroad facilities were obtained from the affected railroads. Estimates of cargo losses and losses due to delay of freight deliveries

were based on data compiled for previous floods throughout the Missouri River basin. The flood damage data in the Kansas City, Missouri area and the Kansas River basin from the floods of May-July 1951 were used to correlate estimates of flood damage to freight transportation systems.

29. EVALUATION OF ASSOCIATED ECONOMIC LOSSES

Flood-related expenditures or loss of income not otherwise classified in categories of direct flood losses were classified as associated economic losses. Estimates of these associated economic losses to the private sector of the economy were computed on the basis of varying percentages of physical flood losses. The factors used to compute these losses were derived from data compiled by the Corps of Engineers' Kansas City District in detailed post-flood studies following the Missouri River and Kansas River floods of May-July 1951. The correlation of the Kansas City District data with the South Platte River basin flood experience was made in terms of basic damage categories on the basis of the relative magnitude of physical damages weighted by the population class of the community or area involved.

30. EVALUATION OF SECONDARY ECONOMIC LOSSES

a. General. Because of the magnitude and extent of damages inflicted by the flood, other economic losses not otherwise classified as direct flood losses or associated economic losses were classified as secondary economic losses. These secondary losses include: loss of tourist income which is an important and increasing contribution to Colorado's economy; loss of State and Federal tax revenues in income tax on a reduced property tax base and casualty loss adjustments; and estimated additional burdens on the regional economy imposed by the interest payments on disaster loans granted by the Small Business Administration.

b. Estimated loss in tourist income. As a result of the June 1965 flood, general vacation tourism in Colorado was down 12.8 percent for the month of June, but recovered later in the summer so the overall total was 5 percent lower than the previous year. The Chambers of Commerce in Durango and Estes Park, mountain cities both well away from the flood area, reported to the State Division of Commerce and Development that their tourist business was from 10 to 15 percent below their June 1964 volume. This indicates that loss in tourist income was not confined to the flood-stricken area. It is assumed that if the 1965 June flood had not occurred, Colorado would have experienced a normal year in tourist trade, which would have been a 5 percent increase over the previous year. Thus, the loss of Colorado tourist income due to the flood was estimated to be 10 percent of the previous year's income.

c. Estimated interest cost for reconstruction loans (SBA). Approximately \$23,000,000 in disaster loans were granted by the Small Business Administration in the Denver area for reconstruction of damaged or flood-raized industrial firms, business establishments, and private dwellings. These loans have a maximum repayment term of 20 years at 3 percent interest a year. Based on \$23,000,000, the interest on these loans was estimated to be \$18,540,000, and is an added financial burden on the recipients of the loans.

d. Estimated loss in State and Federal tax revenues. The tax revenue losses by the State of Colorado and the Federal Government are respectively 5 percent and 12 percent of the direct property casualty losses. These percentages were applied only to the direct physical damages caused by the flood in the South Platte River basin.

31. SCOPE OF FLOODING

The streams of the South Platte River basin on which flooding occurred during June and July 1965 are shown on plate 5. Flooding began on the northern tributaries on 14 June. As the storm moved southward, major flooding occurred on Plum Creek, Cherry Creek, Sand Creek and Toll Gate Creek on the South Platte River and its downstream tributaries - the Cache LaPoudre River, the Big Thompson River, and on the right bank tributary streams - Box Elder, Kiowa, Bijou, Badger and Beaver Creeks. The Plum Creek and Bijou Creek basins received the more intense rainfall and experienced the higher peak discharges. During July, Plum Creek, Cherry Creek, Sand Creek, and the Bijou Creek basins experienced repeated flood runoff which hampered recovery operations and caused additional damages, particularly to temporary stream crossings constructed to accommodate traffic after the bridge destruction in June. Moreover, Bear Creek and Clear Creek, in the metropolitan area of Denver, experienced flooding during the July storms. These two streams had been outside the area of major storm runoff in June. The estimated number of acres flooded during the June floods is tabulated by stream in table 5.

Table 5
ACRES FLOODED IN SOUTH PLATTE BASIN

<u>Sub-Basin</u>	<u>Acres Flooded</u>
South Platte River	132,160
Plum Creek	3,570
Bijou Creek	38,630
Kiowa Creek	7,500
Badger Creek	2,850
Beaver Creek	19,235
Pawnee Creek	4,000
Cache LaPoudre River	6,620
Commanche Creek	2,800
Cherry Creek	2,720
Platte River (North Platte, Nebr. to Gothenburg, Nebr.)	15,400
Sand and Toll Gate Creeks	970
Miscellaneous streams and creeks	16,470
Total Acres Flooded	252,925

32. CHARACTER OF FLOODING

a. General description. In terms of total damages, the damages inflicted by the flood runoff of the northern tributaries of the South Platte River were limited to road closings and moderate damages to farmlands, roads, bridges, and urban property. The flood damages experienced on the streams which received the full brunt of the storm runoff defy adequate description without an intimate knowledge of pre-flood conditions and the benefit of personal inspection. In the Plum Creek basin, interstate highway bridges and sections of highway, which by reasonable standards were adequate to pass major flood flows, were demolished by the extremely high discharges and stages. Heavy road construction equipment such as road graders, huge dump trucks, and cranes which had been parked in the Plum Creek flood plain were almost completely buried under masses of sediment. Farther downstream, farm buildings which were located as much as a quarter of a mile away from the stream bank were carried away. New stream channels appeared where the buildings formerly stood. As the flood proceeded downstream, heavy debris consisting of huge uprooted trees, parts of structures, cars, trucks, fuel tanks, and trailers, was carried on the crest of the flood wave and slammed into other structures. When the Plum Creek flood entered the South Platte River it spread out into the wider South Platte valley. While this valley storage served to reduce the flood crest, the damages inflicted on metropolitan Denver suggested initially that no appreciable reduction in the flood crest had occurred. Houses, bridges, trucks, trailers and cars, as well as large quantities of material from commercial and industrial inventories were added to the destructive force of the

flood's crest. After the flood wave passed downstream, the aftermath of debris, silt, and mud presented a scene of desolation which could only partially suggest the heartbreak and despair of the flood victims. In many instances, the losses suffered by property owners represented the accumulated capital assets of a lifetime of hard work which were destroyed in a brief period of less than an hour.

b. Below Denver. As the Plum Creek flood passed through Denver, it was joined by the flood discharge from Sand Creek which, together with its tributary Toll Gate Creek, had just passed through another sector of metropolitan Denver destroying bridges and private property. The combined flows then passed on downstream in the South Platte valley destroying or damaging roads, bridges, irrigation structures and agricultural property in the irrigated areas of the valley. The flood flows from the upper South Platte basin were joined successively by the floods coming out of the Cache LaPoudre River, Box Elder Creek, Crow Creek and Kiowa Creek. The flood crest gradually diminished as it passed downstream in the South Platte River valley until it was joined by the flood discharge from Bijou Creek which was later computed to have been 466,000 cubic feet per second. This flood volume then increased the area of inundation and destruction for an additional 190 miles along the South Platte River and approximately 35 miles along the Platte River valley downstream from North Platte, Nebraska. The volume of flood flow contributed by the upper South Platte River and Bijou Creek was joined by the flood discharges of Badger and Beaver Creeks as the floods proceeded downstream toward the Platte River.

c. Loss of life. The floods in the South Platte River basin took 13 lives. Four lives were lost on Plum Creek, three on the Cache LaPoudre River, two on Bijou Creek, two on Beaver Creek, and one each on the Big Thompson River and Cherry Creek.

d. Urban areas affected. Among the principal cities in the South Platte River basin, metropolitan Denver suffered the greatest amount of damage. Among the other principal cities in the basin, only Fort Collins, Colorado and Greeley, Colorado suffered flood damages ranging from minor damages at Fort Collins to moderate damages at Greeley, both from flooding on the Cache LaPoudre River. The smaller cities of Brighton, Fort Morgan, Sterling, and Julesburg in Colorado, and Ogallala and North Platte in Nebraska, suffered varying degrees of lesser damages from overflow of the South Platte River. In addition, a number of smaller towns located along the South Platte River and in the various tributary basins sustained damages ranging from relatively minor to almost complete destruction. Major damages were inflicted on the towns of Deer Trail and Byers in the Bijou Creek basin, and the towns of Crook, Ovid and Brush in the lower South Platte basin. In the Plum Creek basin, the towns of Castle Rock, Sedalia, and Louviers suffered heavy damages.

e. Bridges, roads and railroads. Throughout the South Platte basin, 108 bridges, including Federal, State and county highway bridges as well as city bridges were destroyed or severely damaged. Nearly every highway and railroad bridge crossing the South Platte River and Plum, Sand and Toll Gate Creeks was damaged or destroyed. Several State bridges and most of the county bridges across Kiowa Creek, Commanche Creek and Cherry Creek also were damaged or destroyed. Although many bridge approaches were washed out on Beaver Creek, Lone Tree Creek, Lodgepole Creek, Pawnee Creek, Crow Creek and the Cache LaPoudre River, only a few bridges were totally destroyed in these drainage basins. Railroad damage throughout the entire area was severe, with numerous bridges damaged or destroyed and trackage and ballast washed away. It is estimated that from 700 to 900 miles of highways, roads and railroads sustained varying degrees of damage.

33. DAMAGE SUMMARIES

a. General. Estimates of the damages caused by the June 1965 floods in the South Platte River basin are summarized in tables 6 through 10. All damage summaries include direct damages and associated economic losses.

b. Urban flood damage. Urban flood damages in the categories of residential, commercial and industrial, public utilities, publicly-owned facilities, and miscellaneous categories are summarized in table 6. The miscellaneous categories include such items of damages as public and private cleanup, flood fighting, power and telephone facilities, protection of flooded properties, public relief activities, preservation of public health and prevention of disease outbreaks, and others.

c. Rural flood damage. Table 7 summarizes rural flood damages in the categories of farmsteads, livestock, crop and cropland, irrigation structures and equipment, and miscellaneous categories. Miscellaneous categories include damage to rural power and telephone companies, debris removal, fences and equipment lost, pest control and preservation of health.

d. Transportation facilities damage. Table 8 summarizes transportation facility damage in the categories of city streets and bridges, State highways and bridges, county roads and bridges, railroads and trucking facilities, and cargo and traffic detours and delays.

e. Sub-basin damage summary. Damage in the three major categories, rural, urban and transportation by sub-basins within the South Platte River basin, is summarized in table 9.

f. June 1965 flood damage summary. All physical and associated economic damages which resulted from the 14-18 June 1965 flood in the

South Platte River basin are summarized by the three major categories, rural, urban and transportation in table 10. Also included in this summary are the associated secondary economic losses.

VI. DESCRIPTION OF THE FLOODS OF 23-27 JULY 1965

34. STORM PATTERN

a. General. A series of rainstorms during this period was the primary cause of flooding throughout the South Platte River basin. Rainfall was particularly heavy in the Denver area over Plum Creek, Clear Creek, Bear Creek, and Sand and Toll Gate Creek basins. The heaviest amount of rain fell in the Denver and Colorado Springs areas, with some local areas receiving more than an inch of rain. The southwest Denver metropolitan area received 1.95 inches of rain in 30 minutes.

b. Areas of flooding. Heavy rains in the Leavenworth Creek drainage area, a tributary of Clear Creek, caused flooding in the town of Georgetown, Colorado. An estimated 25 families evacuated their homes in the pre-dawn hours on 24 July as water edged up to their doorsills. The Georgetown sewer system was knocked out by the flood, and water supply was contaminated. Telephone communications between Georgetown and Idaho Springs were temporarily knocked out. Clear Creek, which runs through Golden, Colorado ran high, but flooding in Golden was from Tucker Gulch, a tributary of Clear Creek. Flood damage was confined to the north part of Golden where several homes were damaged along with cars and other personal property. Minor damage was done to the city's sewer system. Arvada, Colorado, located on Clear Creek downstream from Golden, sustained flood damage to city and private property. Flood waters in Sellers Gulch and on Plum Creek in the vicinity of Castle Rock were backed up behind land-filled road culverts put up temporarily to handle traffic after the 16 June flood. The only damage in the Castle Rock area was to one trailer parked near the junction of the two creeks and to a motel at the water's edge which also was damaged during the previous flood. This damage was believed to be caused by the backup of water behind the temporary fills of the highway department. Both Big Dry and Little Dry Creeks were rushing torrents for several hours 26 July causing minor damage to the city park in Englewood. Little Dry Creek was widened a few years ago and this improvement undoubtedly reduced the private damage to almost nothing. A series of thundershowers over the Sand and Toll Gate Creek basins resulted in flash flooding in Aurora. A number of basements in the older portion of the city were flooded. Floodwaters from the South Platte River in the Littleton area forced 300 to 400 persons to evacuate their homes the evening of 24 July. Approximately 30 homes, 72 trailers, and six businesses were affected by the high water, but damage was far less than that of the flood of 16-18 June. In Sheridan, along Bear Creek, about 75 homes and 300

trailers were evacuated because of the rising flood waters but only minor damage was sustained. Heavy runoff washed out railroad trackage which in turn caused the derailment of two passenger trains. One derailment near Sterling, Colorado, injured about 45 passengers, nine critically. The other derailment occurred in the mountains about 35 miles west of Denver. The 404 passengers aboard the derailed train escaped injury.

c. Damage summary. During the period of 23-27 July, other drainage basins throughout the South Platte valley sustained damage from flood waters. Flooding during this period was not as severe as the 16-18 June 1965 flood, but some flood damage was experienced in almost every tributary basin of the South Platte River. The majority of the damages sustained were to the temporary fills used for river and creek crossings, and repair work on bridges and roads damaged during the 16-18 June 1965 flood. Jefferson County alone reported an estimated \$257,600 in damages to highways, roads, and bridges. Clear Creek and its tributaries caused an estimated \$80,000 in damages to roads, bridges, and utilities in the town of Golden, Colorado. Arvada, Colorado, just downstream of Golden, sustained damage amounting to about \$40,000. A partial estimate of total damages sustained in the South Platte basin amounts to \$623,000. A detailed survey of the damages during this period of flooding was not conducted since the severity of damage did not warrant such an investigation. The extent of damage and areas flooded were taken from newspaper accounts throughout the period of flooding from 23 to 26 July 1965. All July 1965 damages are totaled with June 1965 flood damages in table 10.

Table 1
DRAINAGE AREAS
SELECTED LOCATIONS
SOUTH PLATTE RIVER BASIN

<u>Stream</u>	<u>Location</u>	<u>Drainage Area Sq. Mi.</u>
Plum Creek	West Sedalia, Colorado	274
Plum Creek	At mouth	324
South Platte R.	At Littleton, Colorado	3,069
Bear Creek	At mouth (Denver)	262
Cherry Creek	At Cherry Creek Reservoir	385
Cherry Creek	At mouth (Denver)	409
South Platte R.	At Denver	3,804
Sand Creek	Near Aurora, Colorado	113
Toll Gate Creek	At E. 6th Ave. (Aurora)	35.8
Sand Creek	At mouth near Denver	191
South Platte	Below Sand Creek confluence	4,023
Clear Creek	Near Golden, Colorado	399
Clear Creek	At mouth near Derby, Colorado	575
South Platte R.	At Henderson, Colorado	4,713
South Platte R.	At Fort Lupton, Colorado	5,010
St. Vrain Creek	At mouth	978
South Platte R.	Below confluence with St. Vrain Creek	6,103
Big Thompson R.	At mouth near LaSalle, Colorado	830
South Platte R.	Below mouth of Big Thompson River	7,127
Cache LaPoudre R.	Near Fort Collins, Colorado	482
Cache LaPoudre R.	Near Greeley, Colorado	1,877
Cache LaPoudre R.	At mouth	1,890
Lone Tree Creek	At mouth	577
South Platte R.	Near Kersey, Colorado	9,598
Crow Creek	At mouth near Barnesville, Colorado	1,377
Box Elder Cr.	At mouth	478
South Platte R.	Near Orchard, Colorado	12,196
Kiowa Creek	At mouth	703
South Platte R.	Near Weldona, Colorado	13,245
West Bijou Creek		326
Middle Bijou Creek		237
East Bijou Creek		435
Big Muddy Creek	At mouth	237
Bijou Creek	At mouth near Fort Morgan, Colorado	1,500
South Platte R.	At Fort Morgan, Colorado	14,810
Badger Creek	At mouth	285
Wildcat Creek	At mouth	158
Beaver Creek	At mouth	1,062
South Platte R.	At Balzac, Colorado	16,852
Pawnee Creek	At mouth near Sterling, Colorado	837
Cedar Creek	At mouth	465

Table 1 (Cont'd)

<u>Stream</u>	<u>Location</u>	<u>Drainage Area Sq. Mi.</u>
South Platte R.	At Ovid, Colorado	19,600
Lodgepole Creek	At mouth at Ovid, Colorado	3,330
South Platte R.	At Julesburg, Colorado	23,138
South Platte R.	At Colorado-Nebraska State line	23,181
South Platte R.	At North Platte, Nebraska	24,300

Table 2
STREAM LENGTHS
SELECTED STREAMS
SOUTH PLATTE RIVER BASIN

<u>Stream</u>	<u>Stream Length Miles</u>	<u>Remarks</u>
South Platte R.	442	Headwaters to mouth
South Platte R.	315	Denver, Colo., to North Platte, Nebraska
South Platte R.	40	Metropolitan Denver reach
Plum Creek	43	Headwaters to mouth
Cherry Creek	63	Headwaters to mouth
Cherry Creek	12	Metropolitan Denver reach
Cache La Poudre R.	121	Headwaters to mouth
Kiowa Creek	114	Headwaters to mouth
Bijou Creek	116	Headwaters to mouth
Crow Creek	140	Headwaters to mouth
Pawnee Creek	52	Headwaters to mouth
Beaver Creek	91	Headwaters to mouth
Lodgepole Creek	216	Headwaters to mouth

Table 3
COMPARATIVE PEAK DISCHARGES
SELECTED STATIONS(a)
SOUTH PLATTE RIVER BASIN

<u>Station</u>	<u>Drainage Area Sq.Mi.</u>	<u>Peak Discharge June 1965 cfs</u>	<u>Prior Peak Discharge cfs (Gaged Record)</u>	<u>Year</u>
South Platte R. @ Waterton, Colorado	2,621	1,370	5,700	1942
E. Plum Creek Nr. Castle Rock, Colorado	115	126,000	--	--
W. Plum Creek Nr. Sedalia, Colorado	122	36,800	--	--
Plum Creek Nr. Louviers, Colorado	302	154,000	3,800	1954
South Platte R. @ Littleton, Colorado	3,069	104,000	9,720	1942
Cherry Creek Nr. Melvin, Colorado	336	39,900	--	--
Piney Creek Nr. Melvin, Colorado	--	14,100	--	--
South Platte River @ Denver, Colorado	3,804	40,300	22,000	1933
Sand Creek @ Sable Ave., Aurora, Colorado	113	13,400	7,660	1957
Toll Gate Creek @ E. 6th Ave., Aurora, Colo.	35.8	17,000	10,400	1957
Sand Creek Below Toll Gate Creek @ Denver	187	18,900	25,500	1957
Clear Creek @ Mouth Nr. Denver	575	3,000	3,650	1938
S. Platte R. @ Ft. Lupton, Colorado	5,010	36,900	9,000	1942
St. Vrain Creek @ Mouth Nr. Plattsville, Colorado	976	2,800	11,300	1938
Cache La Poudre R. Nr. Greeley, Colorado	1,877	4,000	4,220 ^(b)	1917
Lone Tree Creek Nr. Nunn, Colorado	199	6,040	775	1955
So. Platte R. Nr. Kersey, Colorado	9,598	18,700	31,000	1921
Crow Creek Nr. Keota, Colorado	709	4,000(est.)	--	--

Table 3 (Cont'd)

Station	Drainage Area Sq.Mi.	Peak Discharge June 1965	Prior Peak Discharge	Year
		cfs	cfs	
Coal Creek Nr. Briggsdale, Colorado	--	5,340	--	
Kiowa Creek Nr. Eastonville, Colo. @ K-79 Reservoir	3.2	2,270	5,270	1957
Kiowa Creek Sub- Watershed J-33 Nr. Eastonville, Colo.	1.12	2,560	193	1957
Kiowa Creek Sub- Watershed R-3 Nr. Elbert, Colorado	2.82	1,960	1,090	1963
Kiowa Creek Sub- Watershed No. Q-51 Nr. Elbert, Colo.	0.59	1,220	114	1963

NOTES:

(a) Includes only stations with estimates of peak discharges for June 1965 floods.

(b) Daily average discharge.

Kiowa Creek @ Elbert, Colorado	28.6	41,500	43,500	1935
West Kiowa Cr. Elbert, Colorado	35.9	20,000	92	1957
Kiowa Cr. @ Kiowa, Colo.	111	19,700	5,980(c)	1935
Kiowa Cr. @ Bennett, Colo.	236	24,900	14,200	1957
East Bijou Creek @ Deertrail, Colorado	308	274,000	No Records	
Middle Bijou Creek @ Deertrail, Colorado	187	145,000	No Records	
West Bijou Creek Nr. Kiowa, Colorado	92	67,200	No Records	
West Bijou Creek @ Byers, Colorado	314	75,500	No Records	
Bijou Creek Nr. Wiggins, Colorado	1,314	466,000	50,100(d)	1951
S. Platte River @ Fort Morgan, Colorado	14,814	Gage Height 18.2'	33,800(e) G.H. 12.91 ft.	1951

Notes:

(c) At site 12 mi. downstream - 110,000 cfs - 1935.

(d) Max. discharge known probably occurred 31 May 1935.

(e) Max. flood known - 84,300 cfs - 31 May 1935.

Table 3 (Cont'd)

<u>Station</u>	<u>Drainage Area Sq.Mi.</u>	<u>Peak Discharge June 1965 cfs</u>	<u>Prior Peak Discharge cfs</u>	<u>Year</u>
Beaver Creek Nr. Brush, Colo.	--	24,300	No Records	
S. Platte R. @ Balyac, Colorado	16,852	123,000	31,200(f)	1921
North Pawnee Creek Nr. New Raymer, Colorado	--	6,280	No Records	
Pawnee Creek Nr. Stoneham, Colorado	--	26,700	No Records	
Pawnee Creek Nr. Sterling, Colo.	--	N.A.	No Records	
S. Platte R. @ Julesburg, Colo.	23,138	N.A.	31,300	1935
S. Platte R. @ Paxton, Nebraska	23,700	34,600	16,900	1942
S. Platte R. @ North Platte, Nebraska	24,300	22,200	37,100	1935

NOTES:

- (f) Daily discharge, max. Q not determined - maximum discharge probably occurred 31 May 1935 - G.H. 11.43 ft.
N.A. - Not Available.

Table 6
URBAN FLOOD DAMAGE (JUNE 1965 FLOOD)

Town	1960 Pop.	Residential	Commercial	Utilities	Publicly Owned Facilities	Misc. Categories	Total
Denver (Metro)	929,383	\$9,944,700	\$163,988,100	\$4,674,800	\$3,128,100	\$3,196,300	\$184,932,000
Riverside, Colo.	204	152,600	44,400	-	-	600	197,600
Louviers, Colo.	340	18,900	-	21,200	-	7,700	47,800
Sedalia	240	50,800	266,200	3,200	-	49,500	369,700
Castle Rock	1,152	172,300	321,800	73,200	20,700	2,000	590,000
Larkspur	276	55,300	177,400	-	-	110,000	342,700
Wattenberg	171	4,400	-	-	4,200	200	8,800
Ft. Lupton	2,194	-	-	4,300	-	2,200	6,500
LaSalle	1,070	1,200	-	-	-	100	1,300
Evans	1,453	2,500	5,300	-	-	1,000	8,800
Greeley	26,314	29,300	39,600	10,600	-	5,500	85,000
Deertrail	764	153,100	495,000	42,400	5,200	15,400	711,100
Byers	414	24,900	73,700	1,100	2,700	4,000	106,400
Log Lane Village	310	-	-	8,500	-	4,400	12,900
Ft. Morgan	7,379	5,600	69,400	198,200	826,000	5,000	1,104,200
Gary	*	5,600	-	-	15,600	500	21,700
Brush	3,621	116,800	18,800	66,300	3,200	22,000	227,100
Snyder	174	5,900	10,000	-	-	500	16,400
Union	*	8,900	26,700	-	-	1,000	36,600
Marino	1,222	27,700	-	4,600	2,600	2,000	36,900
Messex	*	-	8,000	-	-	1,000	9,000
Atwood	162	74,800	-	-	-	1,700	76,500
Sterling	10,751	112,300	242,100	157,000	-	685,000	1,196,400
Crook	209	37,600	52,300	23,600	3,900	5,000	122,400
Sedgwick	299	99,600	1,800	4,000	-	1,200	106,600
Ovid	571	89,100	16,400	-	1,300	1,100	107,900
Julesburg	1,840	22,500	-	10,700	-	1,500	34,700
Pierce	424	2,000	-	3,200	1,100	700	7,000
Lodgepole, Nebr.	492	8,700	-	-	-	400	9,100
Sidney, Nebr.	8,004	34,400	80,800	5,300	6,200	4,000	130,700
Misc. Areas	-	19,300	132,800	5,200	332,700	-	490,000
Platte R. Valley- Urban Areas	-	-	-	5,200	-	-	5,200
Total	-	\$11,280,800	\$166,070,600	\$5,322,200	\$4,353,500	\$4,131,500	\$191,159,000

*Estimated at 100 or less
(-) Not available from data sources

Table 7
RURAL FLOOD DAMAGE
(JUNE 1965 FLOOD)

Stream Reach Basin	Acres Flooded	Farm & Farm- Steads	Livestock	Crop & Crop Land	Irrigation Structures & Equipment	Misc. Categories	Total
Plum Creek	3,570	\$140,000	\$20,000	\$3,983,000	\$ 34,000	\$ 57,000	\$4,234,000
So. Platte River							
Denver Metro.	15,530	222,000	67,000	1,368,000	39,000	492,000	2,188,000
Brighton to Bijou Cr.	39,890	252,000	8,000	3,490,000	458,000	621,000	4,829,000
Bijou Cr to Colo Line	44,740	1,539,000	3,287,000	4,385,000	8,560,000	1,629,000	19,400,000
Colo Line to No. Platte	32,000	-	-	1,838,000	2,918,000	195,000	4,951,000
Cherry Creek	2,720	16,000	3,000	422,000	4,000	350,000	795,000
Sand Creek	750	8,000	3,000	5,000	61,000	17,000	94,000
Toll Gate Creek	120	12,000	5,000	8,000	1,000	25,000	51,000
Cache La Poudre R.	6,620	63,000	-	213,000	168,000	267,000	711,000
Kiowa Creek	7,500	201,000	52,000	254,000	161,000	812,000	1,480,000
Commanche Creek	2,800	125,000	47,000	93,000	46,000	839,000	1,150,000
Bijou Creek	38,630	77,000	8,000	33,000	512,000	278,000	908,000
Damsite to Fork	-	34,000	2,000	188,000	40,000	159,000	423,000
West Bijou	-	69,000	3,000	384,000	81,000	228,000	765,000
East & Mid. Bijou	-	118,000	6,000	660,000	139,000	408,000	1,331,000
Badger Creek	2,850	108,000	32,000	116,000	95,000	402,000	753,000
Beaver Creek	19,235	150,000	20,000	208,000	137,000	361,000	876,000
Pawnee Creek	4,000	46,000	1,000	219,000	269,000	314,000	849,000
Platte River	15,400	-	-	413,000	-	-	413,000
Misc. Areas	16,470	813,000	125,000	2,682,000	2,018,000	766,000	6,404,000
Total	252,925	\$3,993,000	\$3,689,000	\$20,962,000	\$15,741,000	\$8,220,000	\$52,605,000

Table 8
FLOOD DAMAGE TO HIGHWAYS, BRIDGES AND TRANSPORTATION
(JUNE 1965 FLOOD)

Stream Reach Basin	City Bridge & Streets	State Hwy. & Bridges	Co. Roads & Bridges	Railroads & Trucking Fac, Cargo	Traffic Delays & Detours	Total
Plum Creek	-	\$2,650,000	\$631,000	\$1,018,000	\$2,353,000	\$6,652,000
So. Platte River						
Denver Metro	\$204,000	1,314,000	14,652,000	117,998,000	1,100,000	135,268,000
Brighton to Bijou Cr.	-	380,000	446,000	413,000	639,000	1,878,000
Bijou Cr. to Colo. Line	4,000	1,811,000	1,022,000	688,000	328,000	3,853,000
Colo. Line to No. Platte	-	281,000	-	-	151,000	432,000
Cherry Creek	-	285,000	178,000	-	48,000	511,000
Sand Creek	984,000	400,000	72,000	628,000	23,000	2,107,000
Toll Gate Creek	8,000	-	80,000	367,000	18,000	468,000
Cache La Poudre R.	-	1,368,000	52,000	262,000	233,000	1,915,000
Kiowa Creek	-	162,000	304,000	344,000	254,000	1,064,000
Commanche Creek	-	1,368,000	133,000	275,000	22,000	1,798,000
Bijou Creek	-	642,000	1,318,000	68,000	172,000	2,200,000
Damsite to Fork	-	285,000	193,000	-	172,000	650,000
West Bijou	-	285,000	586,000	276,000	172,000	1,319,000
East & Middle Bijou	-	927,000	1,260,000	2,270,000	172,000	4,629,000
Badger Creek	-	1,369,000	-	69,000	123,000	1,561,000
Beaver Creek	-	285,000	134,000	69,000	117,000	605,000
Pawnee Creek	-	1,369,000	38,000	276,000	105,000	1,788,000
Platte River	-	64,000	-	-	66,000	130,000
Miscellaneous Areas	2,000	1,328,000	342,000	413,000	399,000	2,484,000
Totals	\$1,202,000	\$16,573,000	\$21,441,000	\$125,434,000	\$6,662,000	\$171,312,000

Table 9
SUB-BASIN FLOOD DAMAGE SUMMARY
(JUNE 1965 FLOOD)

<u>Stream-Basin</u>	<u>Rural</u>	<u>Urban</u>	<u>Trans. w/delays</u>	<u>Total</u>
Plum Creek	\$4,234,000	\$1,548,000	\$6,652,000	\$ 12,434,000
So. Platte River				
Denver Metro	2,188,000	184,932,000	135,268,000	322,388,000
Brighton to Bijou Cr.	4,829,000	25,000	1,878,000	6,732,000
Bijou Cr. to Colo. Line	19,400,000	2,676,000	3,853,000	25,929,000
Colo. Line to No. Platte	4,951,000	5,000	432,000	5,388,000
Cherry Creek	795,000	0	511,000	1,306,000
Sand Creek	94,000	316,000	2,107,000	2,517,000
Toll Gate Creek	51,000	169,000	468,000	688,000
Cache La Poudre R.	711,000	85,000	1,915,000	2,711,000
Kiowa Creek	1,480,000	0	1,064,000	2,544,000
Commanche Creek	1,150,000	0	1,798,000	2,948,000
Bijou Creek				
Mouth to Damsite	908,000	0	2,200,000	3,106,000
Damsite to Forks	423,000	0	650,000	1,073,000
West Bijou	765,000	106,000	1,319,000	2,190,000
East & Middle Bijou	1,331,000	711,000	4,629,000	6,671,000
Badger Creek	753,000	0	1,561,000	2,314,000
Beaver Creek	876,000	249,000	605,000	1,730,000
Pawnee Creek	849,000	77,000	1,788,000	2,714,000
Platte River	413,000	5,000	130,000	548,000
Miscellaneous Areas	6,404,000	255,000	2,484,000	9,143,000
Total	\$52,605,000	\$191,159,000	\$171,312,000	\$415,076,000

Table 10
SUMMARY OF JUNE-JULY 1965
FLOOD DAMAGES
SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA

I. June 1965 Flood Damages

Category

Rural losses	\$ 52,605,000	
Transportation damages	171,312,000	
Urban damages	191,159,000	
Subtotal		\$415,076,000

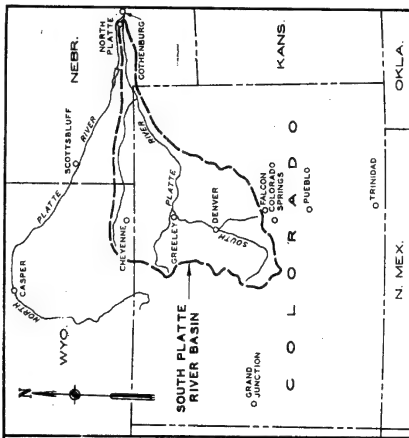
II. Miscellaneous Secondary Economic Losses

Estimated loss in tourist income	\$ 38,600,000	
Estimated interest costs for reconstruction loans (SBA)	18,540,000	
Estimated loss of tax revenues from reduced property tax base and casualty loss adjustments	36,486,000	
Subtotal		\$ 93,626,000

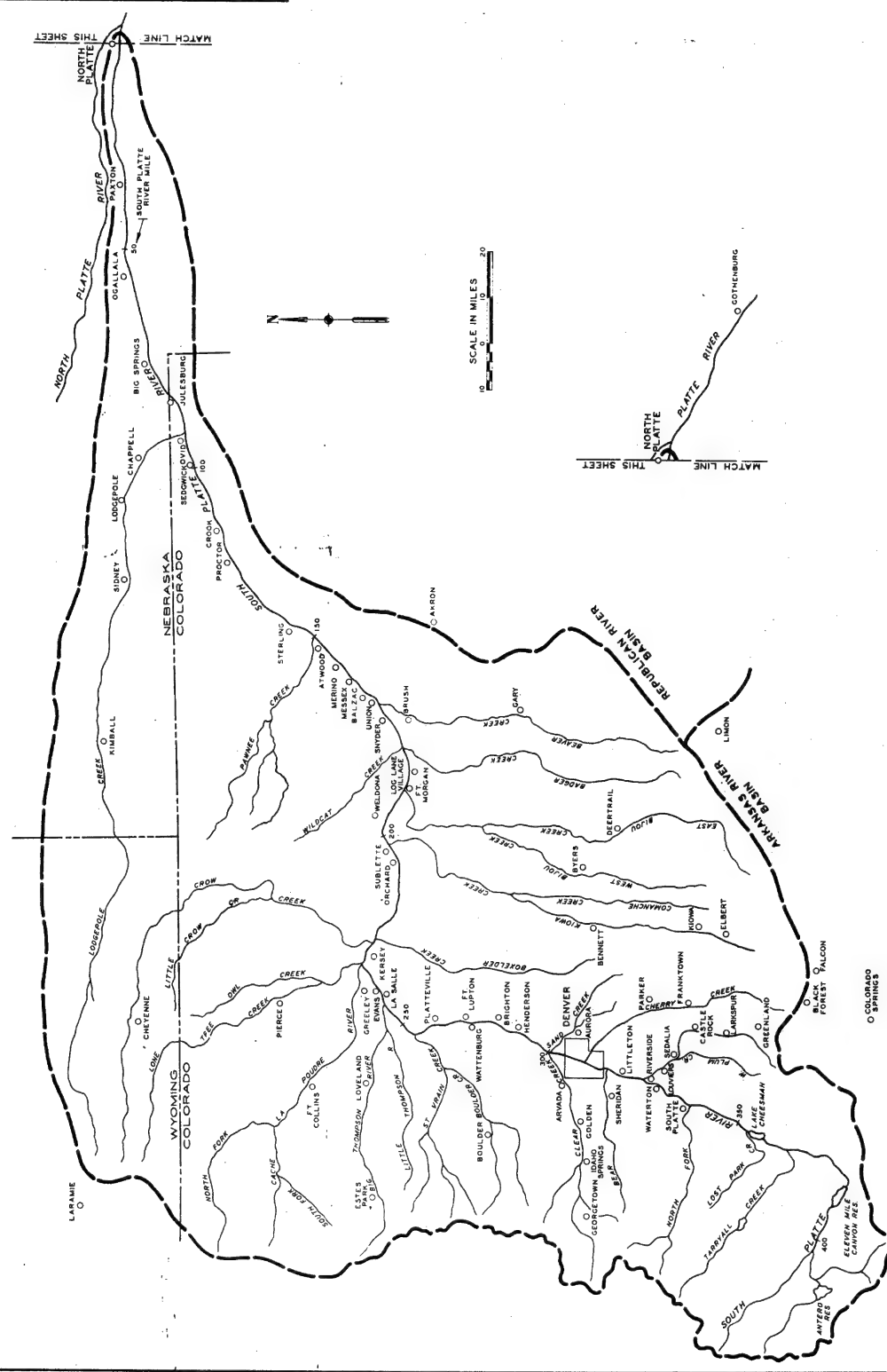
Total of June 1965 flood damages	\$508,702,000
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III. July 1965 Flood Damages

All categories	<u>623,000</u>
GRAND TOTAL of June and July 1965 flood damages	<u><u>\$509,325,000</u></u>



LOCATION MAP



SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

GENERAL MAP

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967

THIS DRAWING HAS BEEN REDUCED TO
ONE-HALF THE ORIGINAL SCALE.



THIS DRAWING WAS MADE BY THE U.S. ARMY
ENGINEERING CENTER, WASHINGTON, D.C.

SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

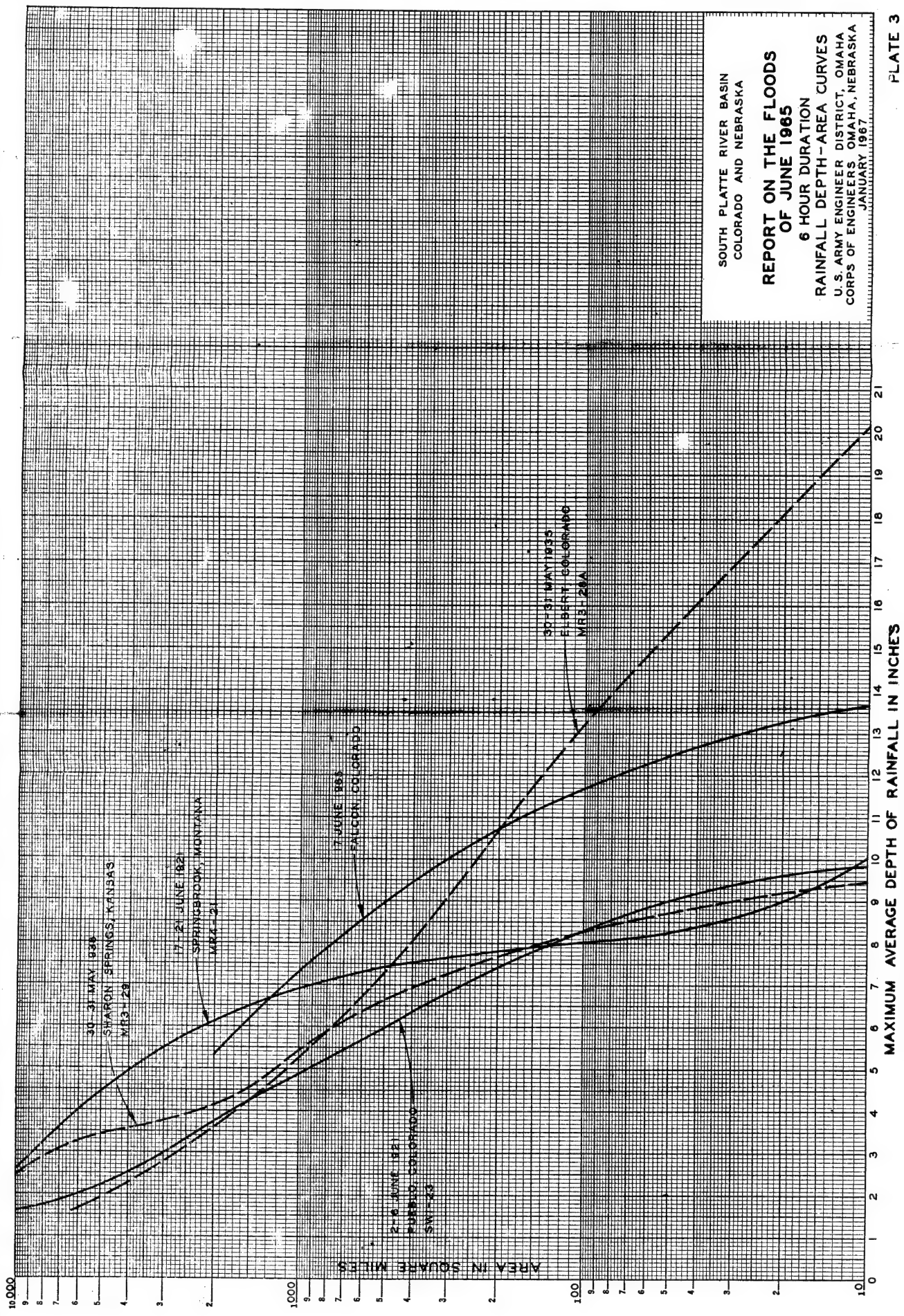
STORM OF 15-17 JUNE 1965

ISOTHERMAL STORM PATTERN

U.S. ARMY ENGINEERING CENTER, WASHINGTON, D.C.

CORPS OF ENGINEERS, WASHINGTON, D.C.

JANUARY 1967



SOUTH PLATTE RIVER BASIN
COLORADO AND NEBRASKA

REPORT ON THE FLOODS
OF JUNE 1965
6 HOUR DURATION

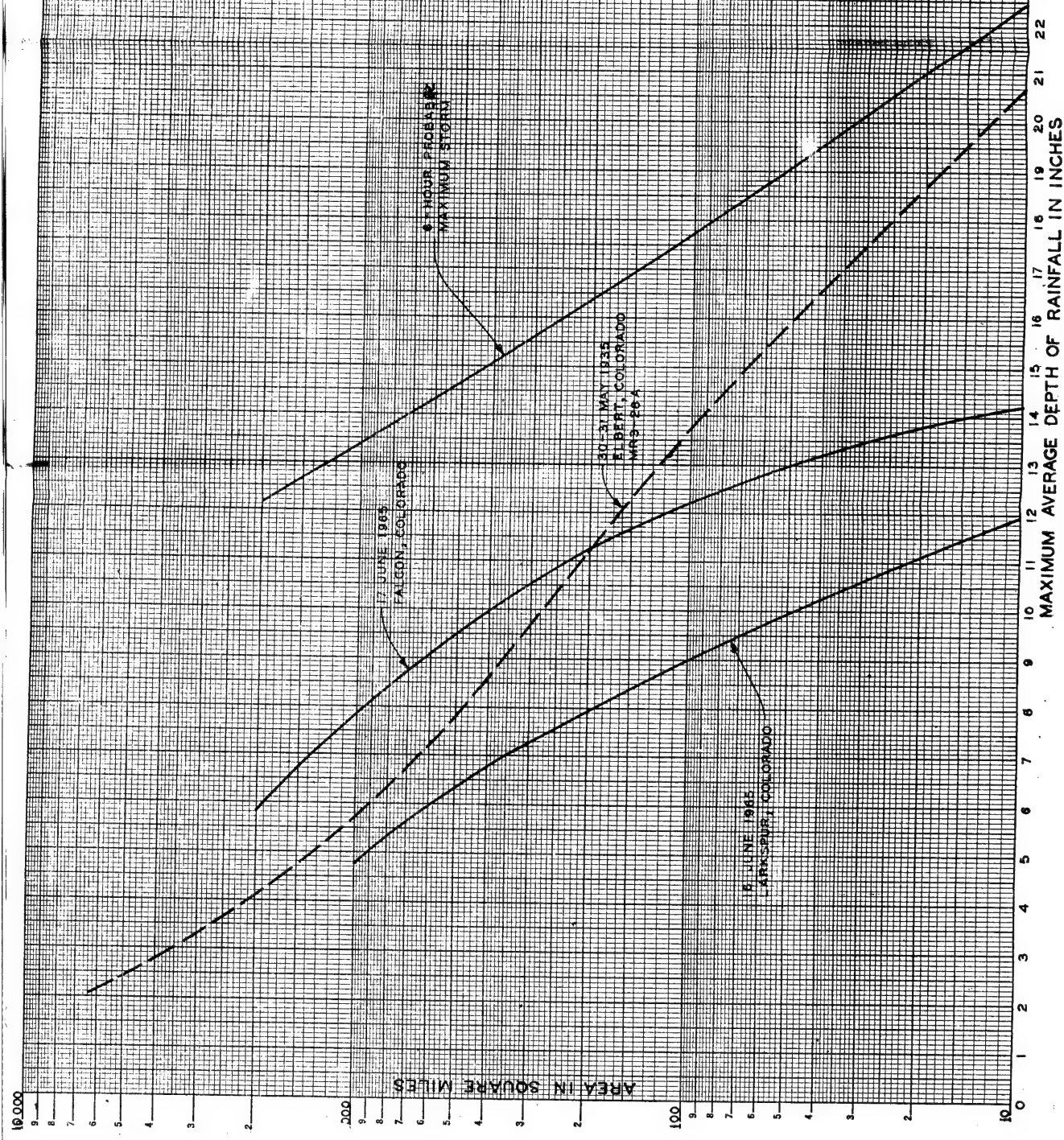
RAINFALL DEPTH-AREA CURVES
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS, OMAHA, NEBRASKA
JANUARY 1967

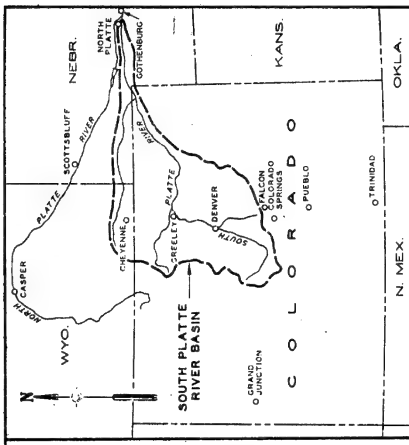
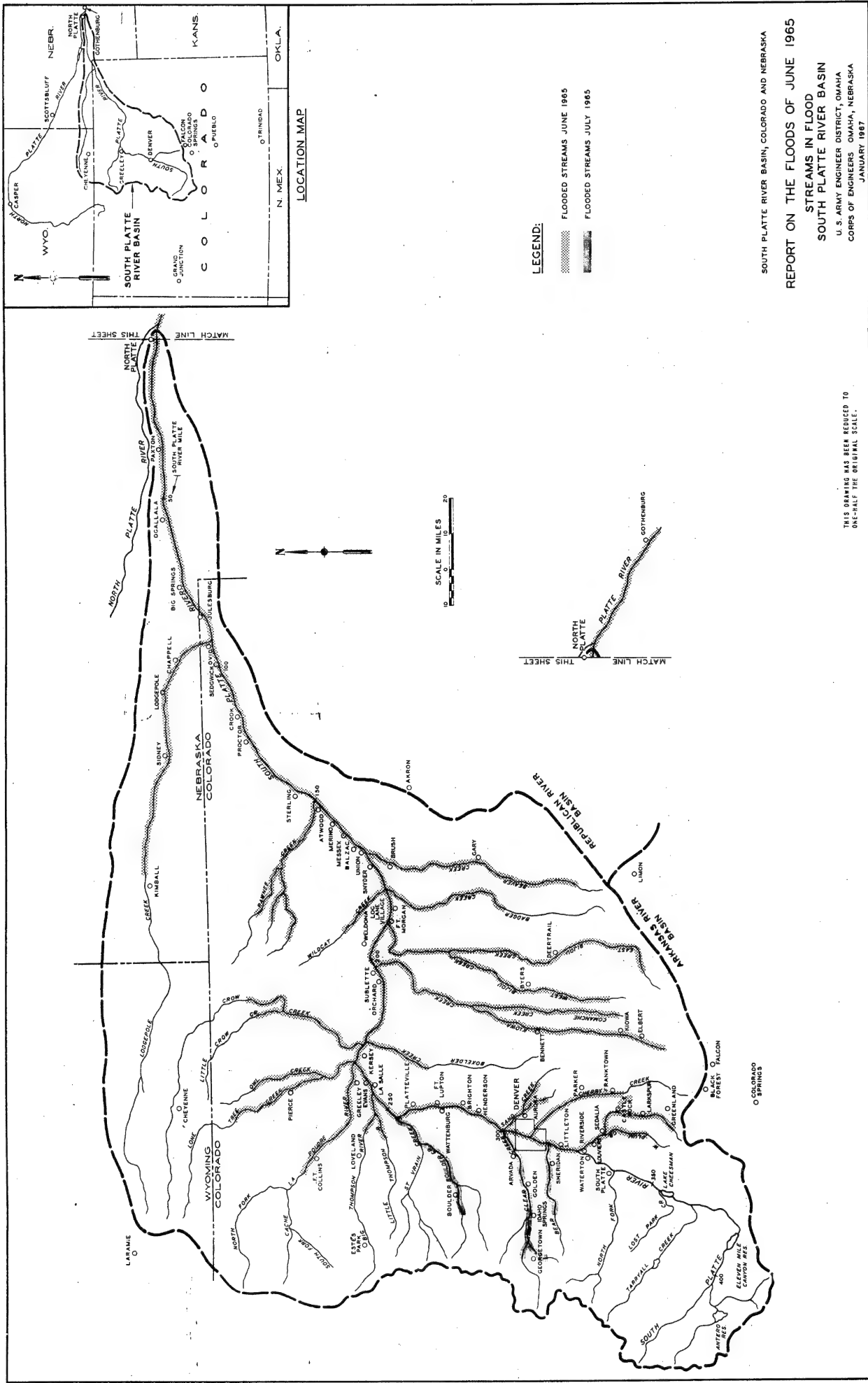
SOUTH PLATTE RIVER BASIN
COLORADO AND NEBRASKA

**REPORT ON THE FLOODS
OF JUNE 1965**
STORM OF 15-17 JUNE 1965
COMPARISON OF 6-HOUR
DEPTH-AREA CURVES

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS, OMAHA, NEBRASKA
JANUARY 1967

PLATE 4





SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA

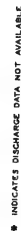
REPORT ON THE FLOODS OF JUNE 1965

STREAMS IN FLOOD

SOUTH PLATTE RIVER BASIN

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967

THIS DRAWING HAS BEEN REDUCED TO ONE-HALF THE ORIGINAL SCALE.



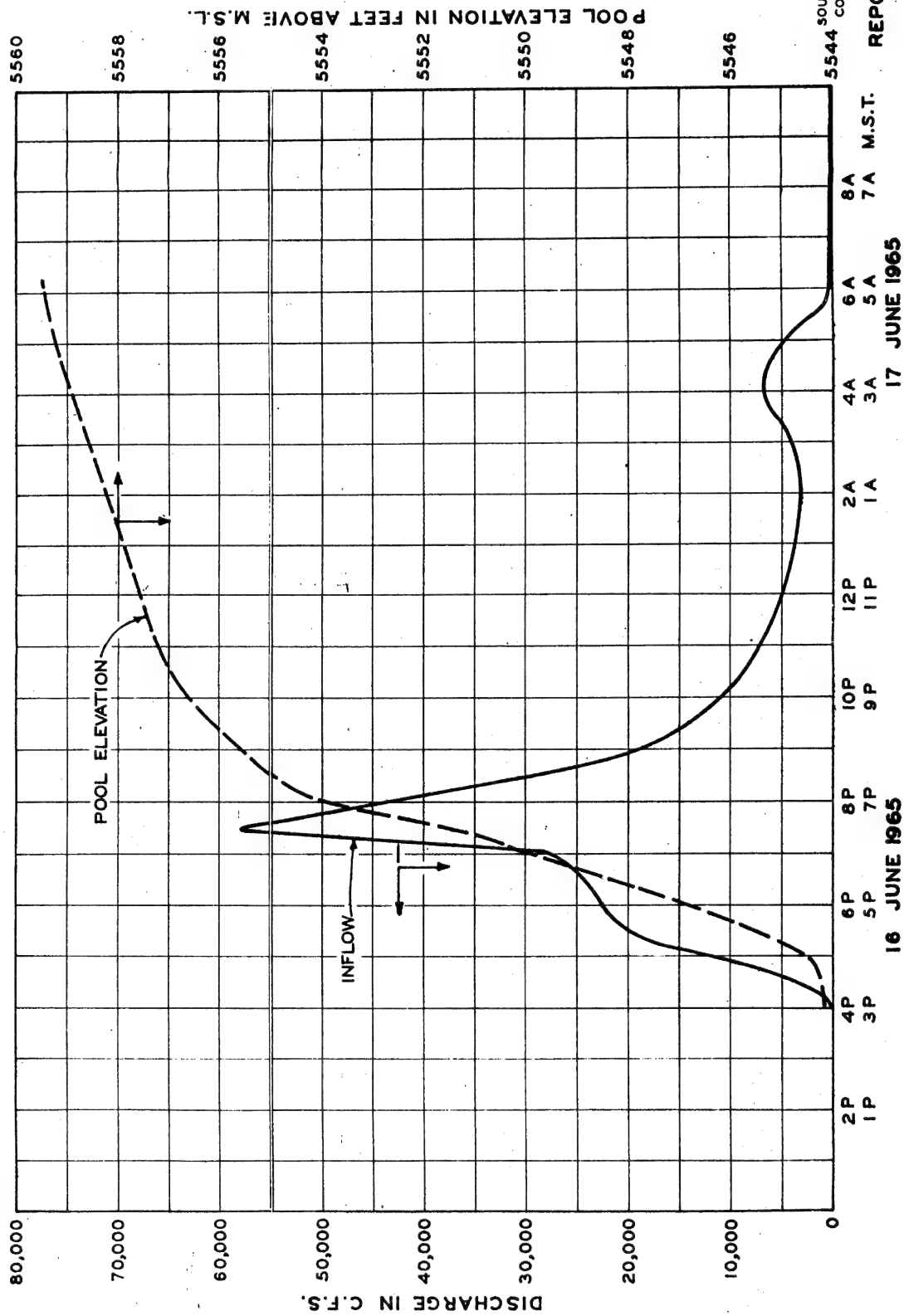
NOTE: TRIBUTARIES ARE NOT TO SCALE

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U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

NEENES OMAHA
JANUARY 1967

PLATE 6



5544 SOUTH PLATTE RIVER BASIN
COLORADO AND NEBRASKA

REPORT ON THE FLOODS
OF JUNE 1965
STORM OF 15-17 JUNE 1965
CHERRY CREEK RESERVOIR
INFLOW HYDROGRAPH
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967

REPORT ON THE FLOODS
OF JUNE 1965
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

APPENDIX I
DATA ON FLOOD LIMITS

REPORT ON THE FLOODS
OF JUNE 1965
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

APPENDIX I
DATA ON FLOOD LIMITS

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REPORT ON THE FLOODS
OF JUNE 1965
SOUTH PLATTE RIVER BASIN
COLORADO AND NEBRASKA

APPENDIX I
DATA ON FLOOD LIMITS

I. INTRODUCTION

1. SCOPE

This appendix is provided to illustrate the general limits of overbank flooding on the South Platte River and its tributaries during the period of flooding from 14 to 18 June 1965. This appendix also includes high water mark survey data collected in the Denver metropolitan area along the South Platte River from the mouth of Plum Creek to Brighton, Colorado, and the lower portions of Sand and Toll Gate Creeks from Aurora, Colorado, to the mouth of Sand Creek.

II. DESCRIPTION OF FLOOD LIMITS

2. FLOOD OUTLINES

a. General. Limits of the overbank flooding on the South Platte River and its tributaries were established during and after the period of flooding from 14 to 18 June 1965. Flood outlines were compiled from information obtained in the field by Corps of Engineers personnel, from aerial photographs, and from data furnished by the Region 7 office of the Bureau of Reclamation. In the Denver metropolitan area, flood outline surveys of overbank flooding were conducted by the cities of Englewood and Denver. The limits of overbank flooding of numerous smaller tributaries were not determined due to lack of adequate mapping and related data. The upland areas of these tributary watersheds are used for dryland farming and grazing land. Extensive damage in these areas was sustained by county and State transportation systems. Damage by erosion and sedimentation was sustained by farmland located in the flood plains of these tributaries. Plate 5 of the main report illustrates all streams which were in flood during the period 14-18 June 1965.

b. South Platte River basin. The flooded outline on the South Platte River extends from the mouth of Plum Creek to Gothenburg, Nebraska on the Platte River below the confluence of the North and South Platte Rivers. Tributaries for which limited areas of flood outlines were established are: Plum Creek, Cherry Creek, Sand and Toll Gate Creeks, Cache La Poudre River, Bijou Creek, Crow Creek, Pawnee Creek, and Beaver Creek. Flood outlines for these tributaries and the South Platte River are illustrated on plates 1 through 8 of this appendix.

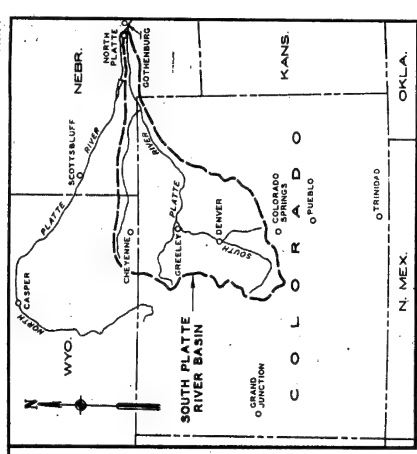
c. Denver metropolitan area. In October 1963 and April 1964, the Corps of Engineers published volumes I and II of its report on flood plain hazards along the metropolitan Denver reaches of the South Platte River and Sand, Toll Gate, and Cherry Creeks. The report contains maps of the streams which show the indicated flood hazard areas and flood stages which could result from the standard project flood for the watershed. A standard project flood may be defined as a great flood, but one which is characteristic of the area in which it occurs. To illustrate the magnitude of the June 1965 flood in the Denver metropolitan area, the 1965 flood outlines of the South Platte River and Sand and Toll Gate Creeks were plotted on the indicated flood hazard area maps. These comparisons, shown on plates 9 through 23 and plates 33 through 39 of this appendix, illustrate a remarkable similarity of the 1965 flood to the standard project flood.

3. HIGH WATER MARKS

After the June 1965 flood, high water marks were placed along the South Platte River from the mouth of Plum Creek to Brighton, Colorado, and along Sand and Toll Gate Creeks. The locations of these high water marks are shown on plates 24 through 32, and plates 40 through 45 of this appendix.

4. FLOOD PHOTOGRAPHS

Photographs of typical flooding and flood damage conditions are included in this appendix as plates 45 through 59.

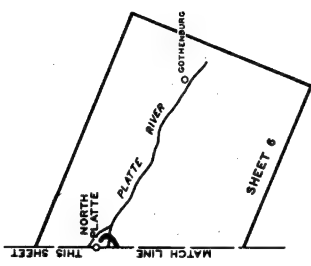
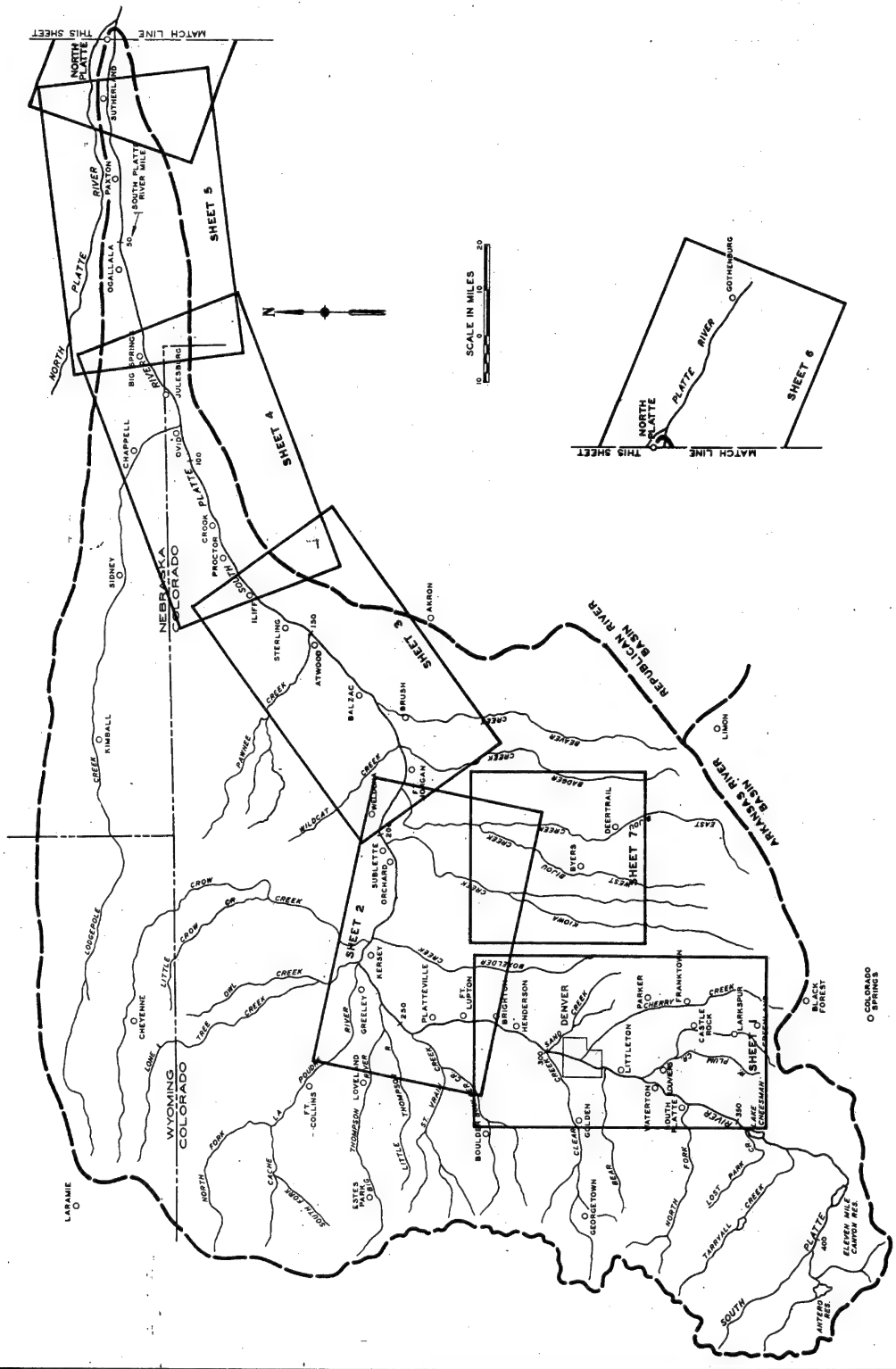


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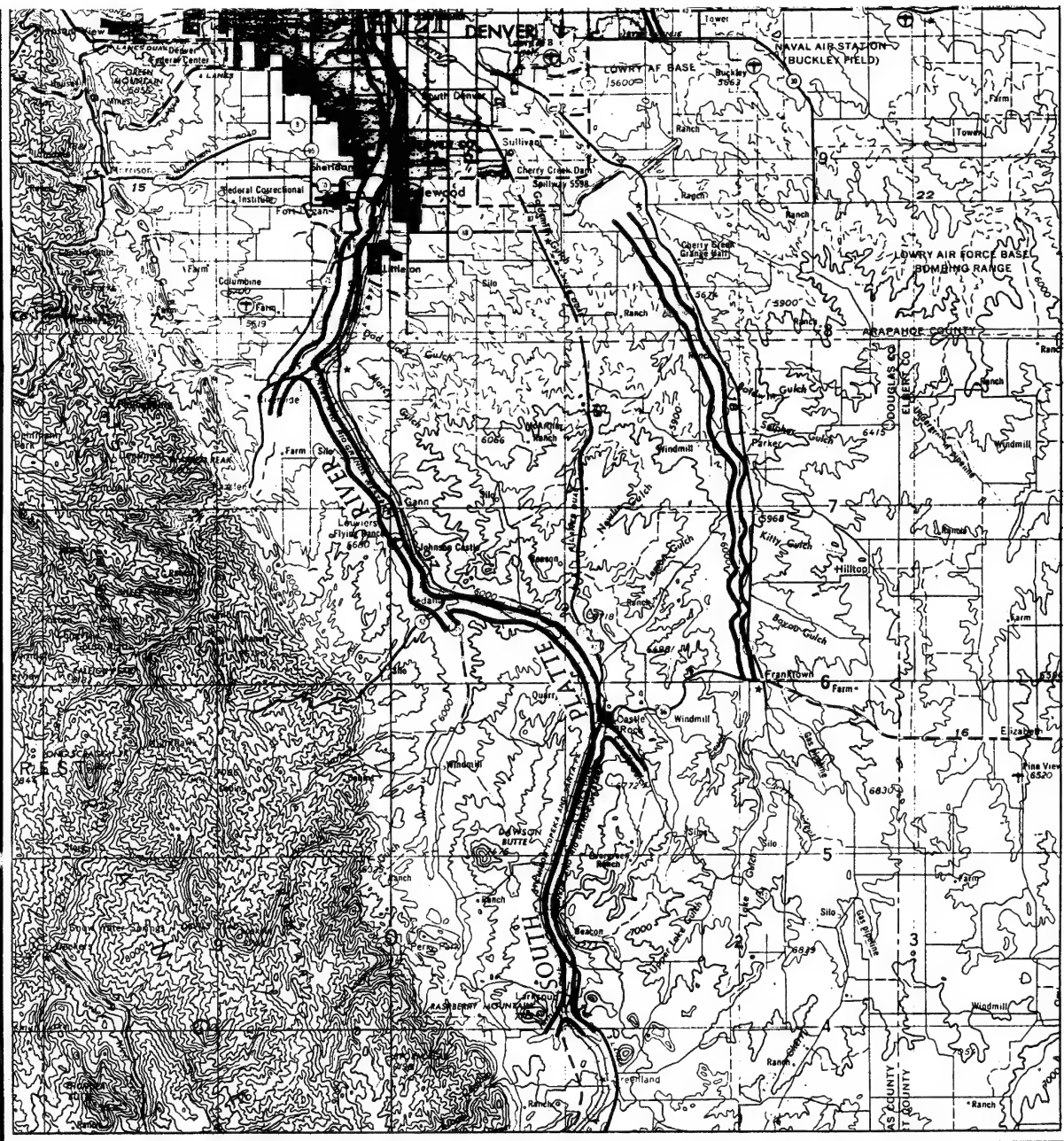
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SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
REPORT ON THE FLOODS OF JUNE 1965
INDEX OF FLOOD OUTLINE MAPS
SOUTH PLATTE RIVER AND TRIBUTARIES
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967



0

LEGEND

1965 Flood Outline

NOTE:

1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

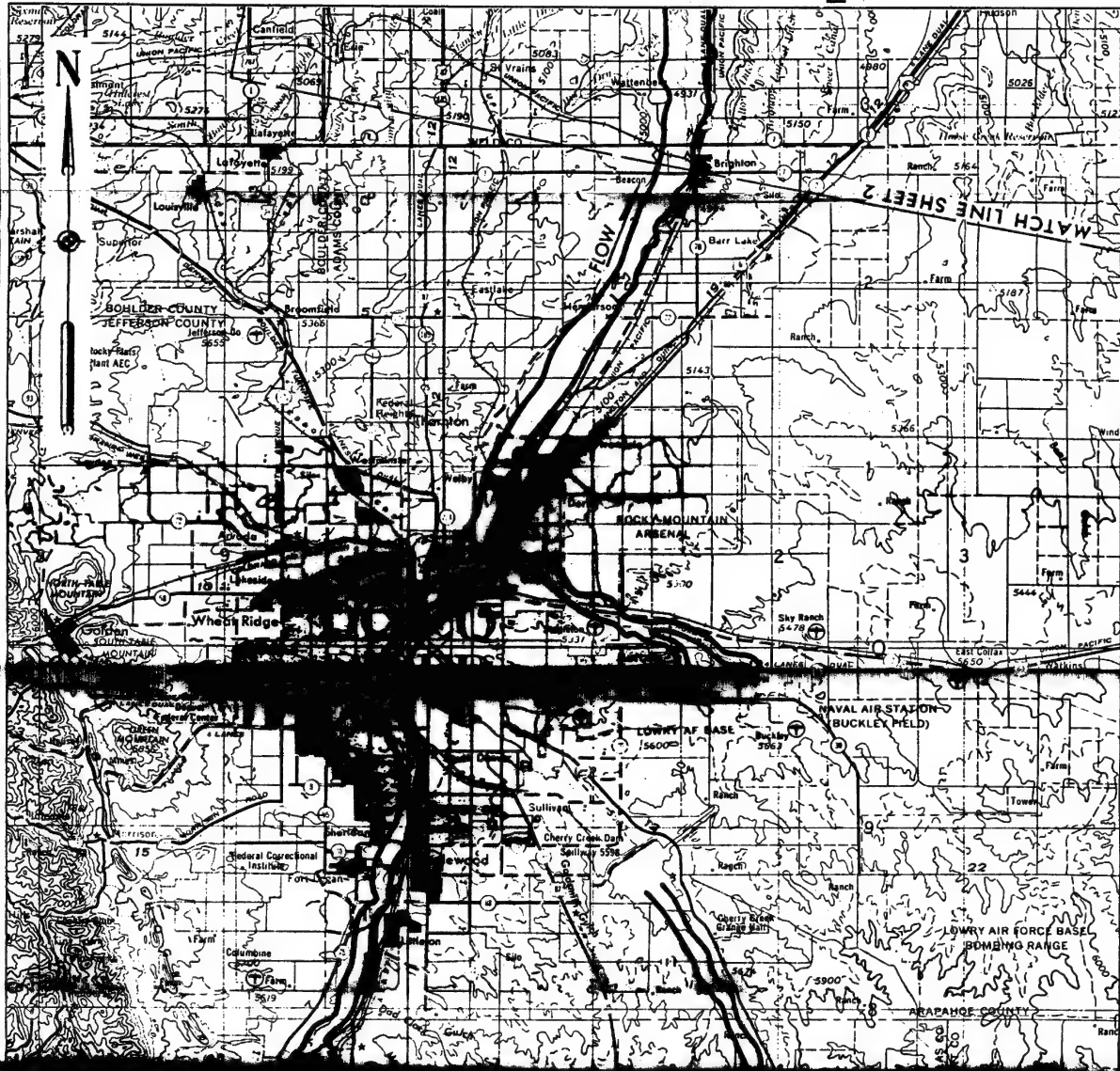
FLOOD OUTLINE OF SOUTH PLATTE RIVER
AND TRIBUTARIES
LARKSPUR, COLO. TO BRIGHTON, COLO.

SCALE IN MILES



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967
SHEET 1 OF 7

APPENDIX I PLATE 2



2

LEGEND

1965 Flood Outline



NOTE:

1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

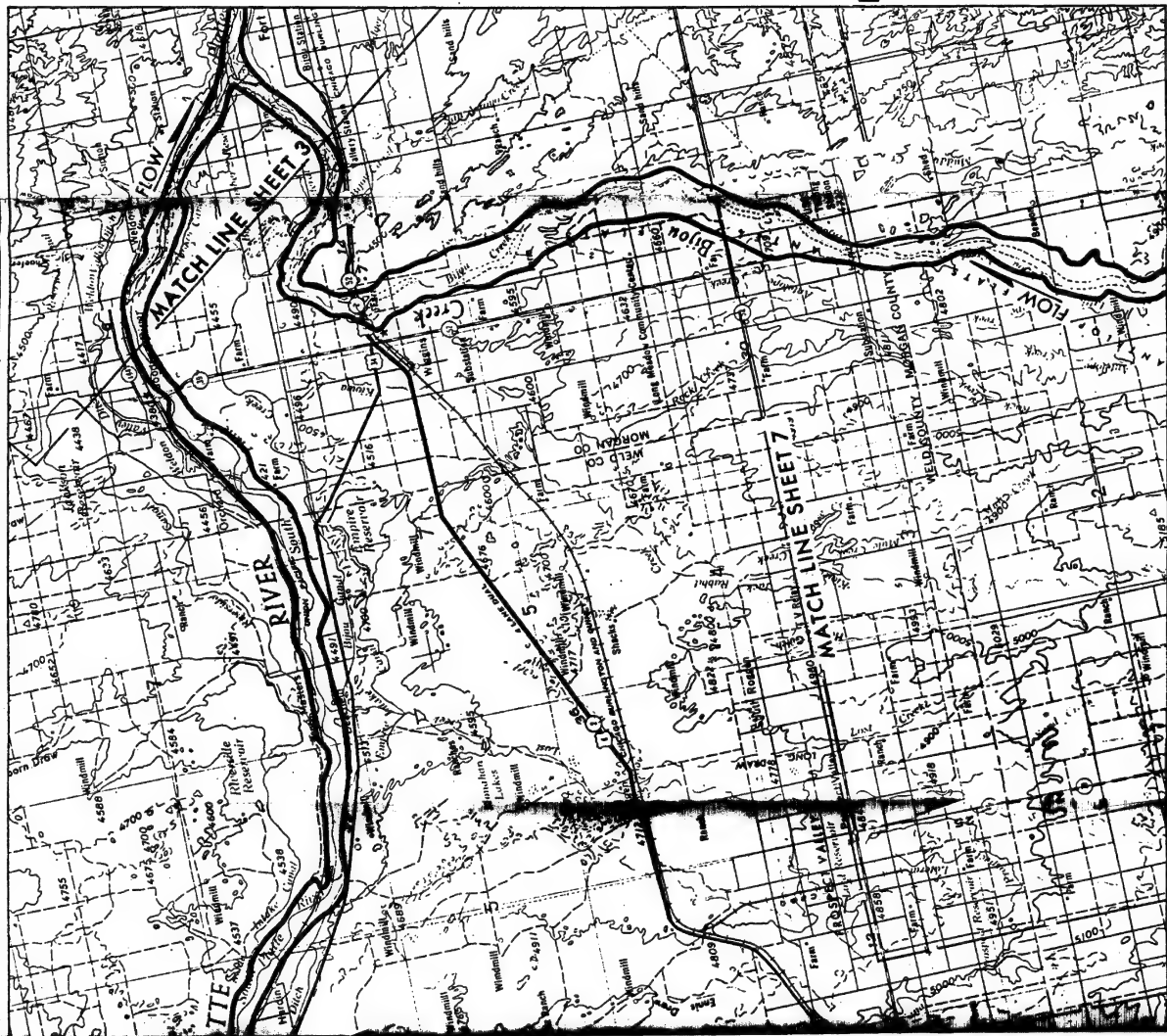
FLOOD OUTLINE OF SOUTH PLATTE RIVER
AND TRIBUTARIES
BRIGHTON, COLO. TO FORT MORGAN, COLO.

SCALE IN MILES

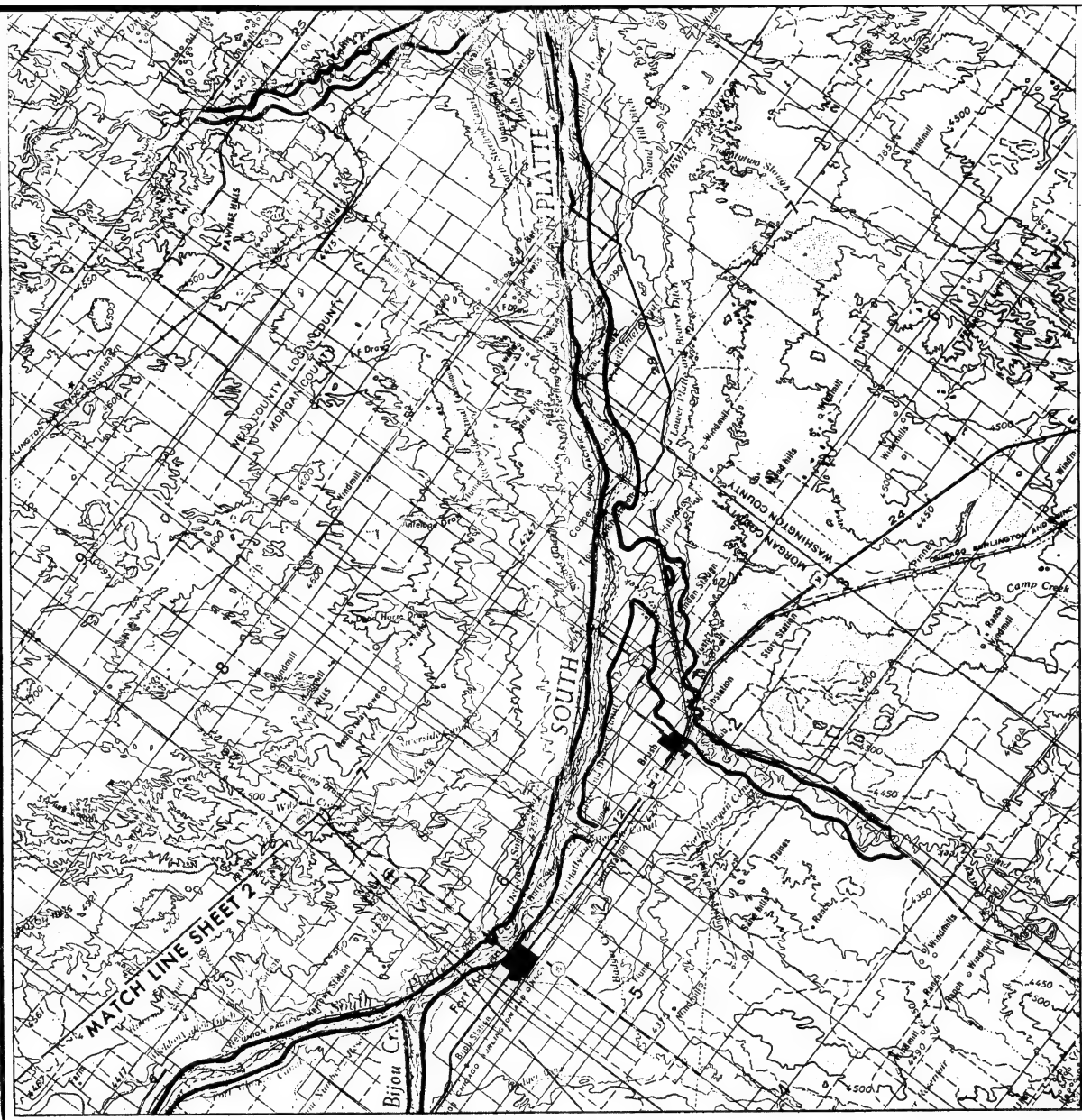


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CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967
SHEET 2 OF 7

APPENDIX I PLATE 3



2



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LEGEND

1965 Flood Outline



NOTE:

1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

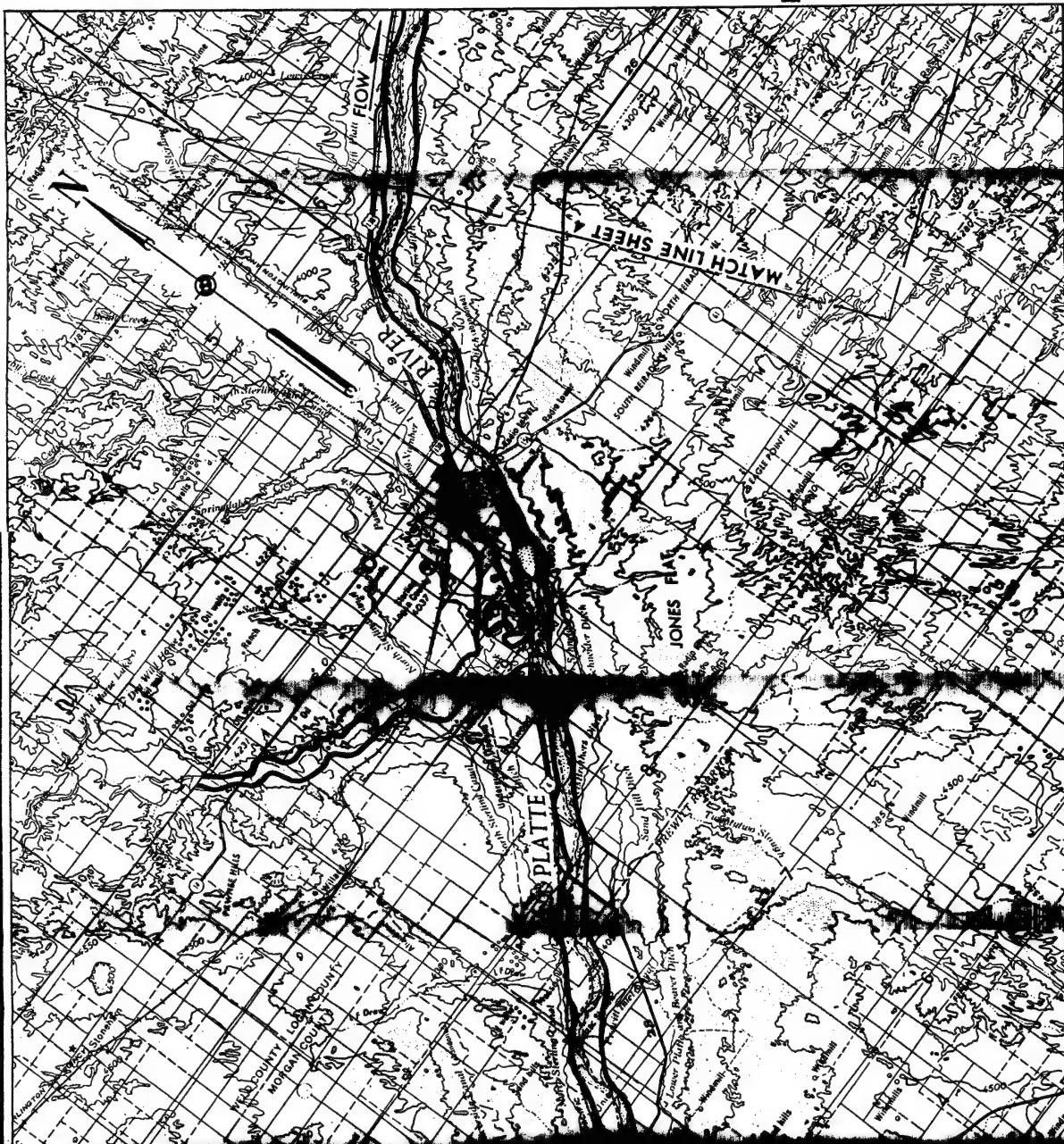
FLOOD OUTLINE OF SOUTH PLATTE RIVER
AND TRIBUTARIES
FORT MORGAN, COLO. TO ILLIFF, COLO.

SCALE IN MILES



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 3 OF 7

APPENDIX I PLATE 4



(2)

LEGEND

1965 Flood Outline

NOTE:

1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

FLOOD OUTLINE OF SOUTH PLATTE RIVER
AND TRIBUTARIES
ILIFF, COLO. TO BIG SPRINGS, NEBR.

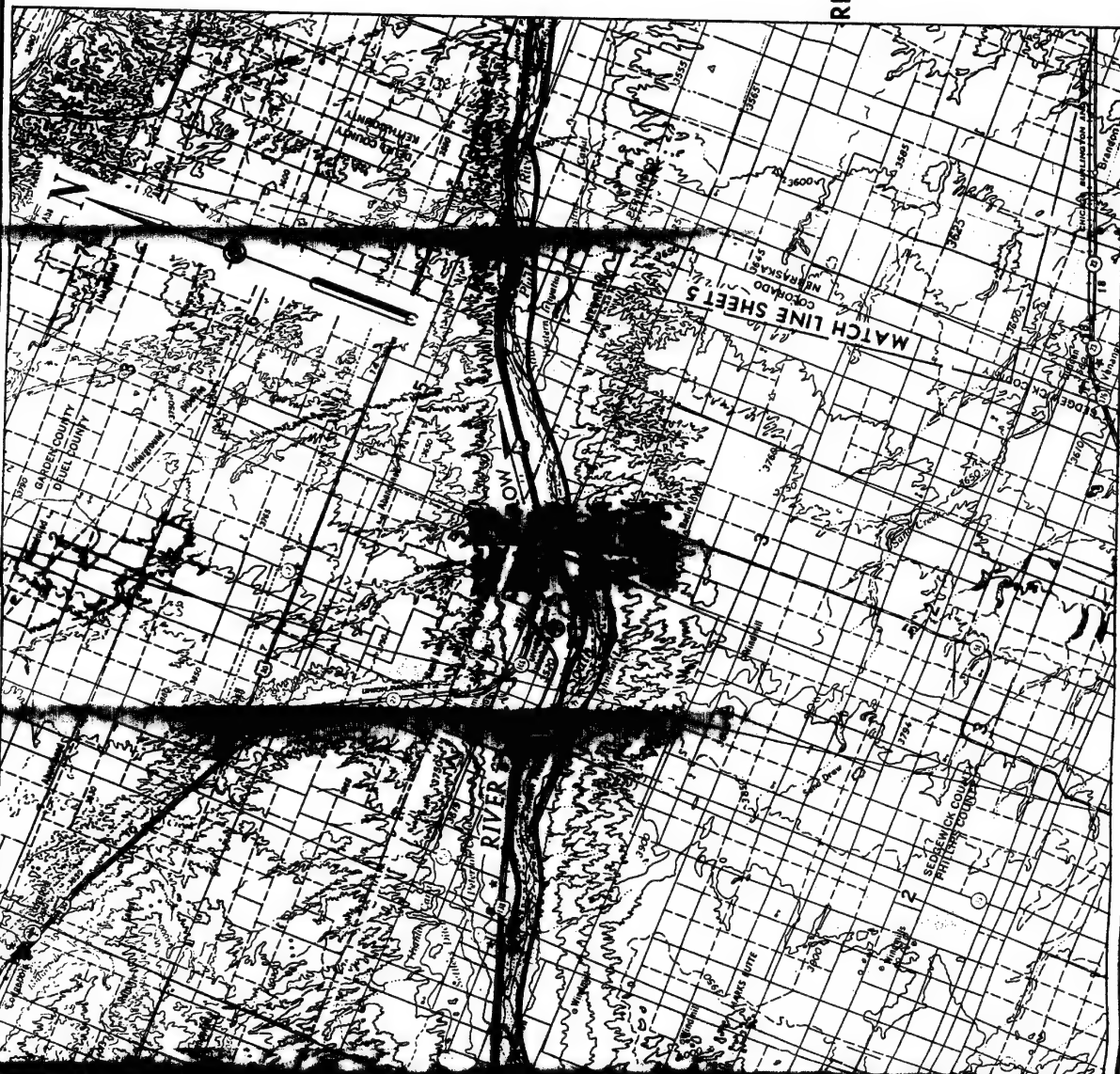
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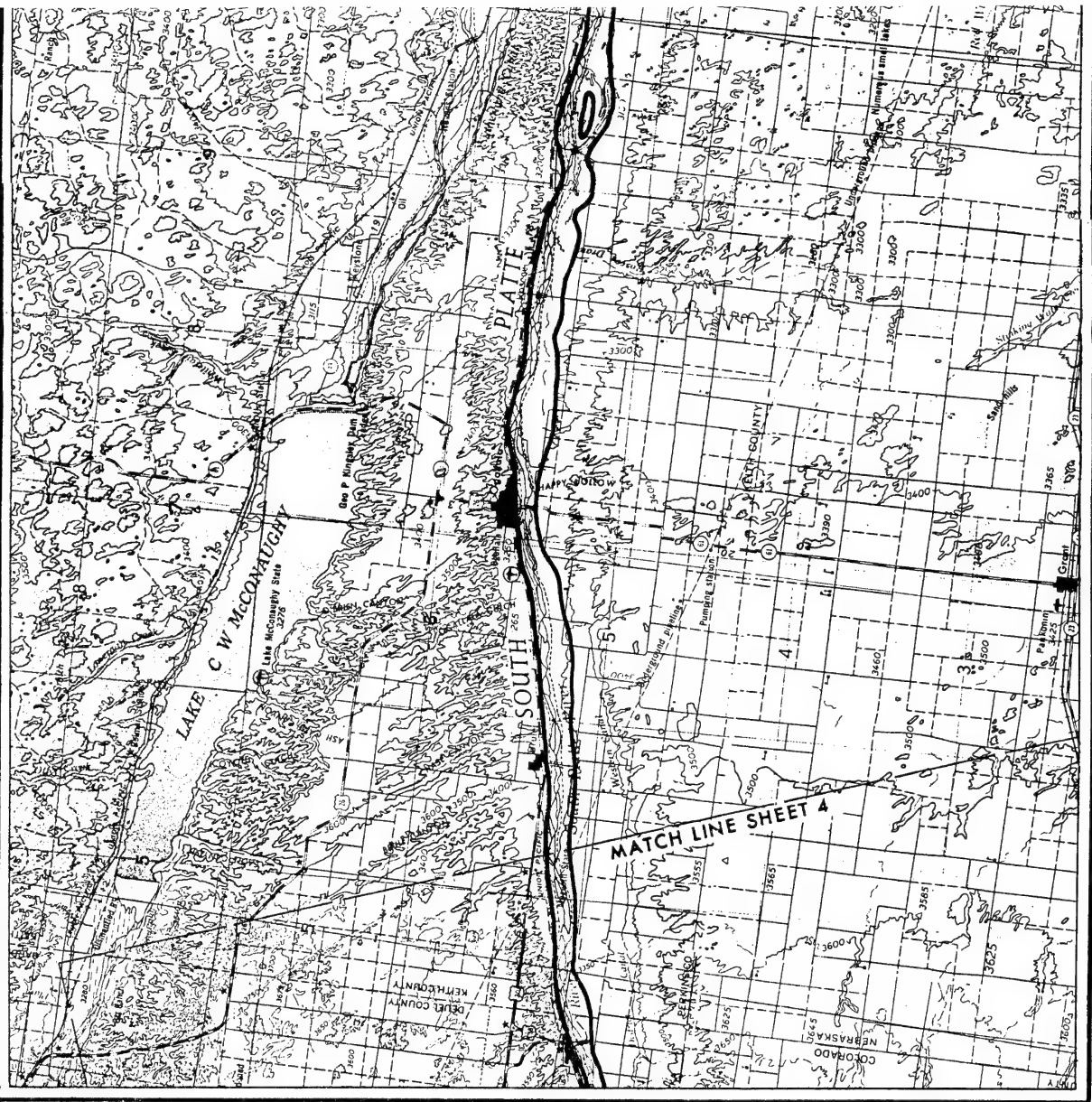


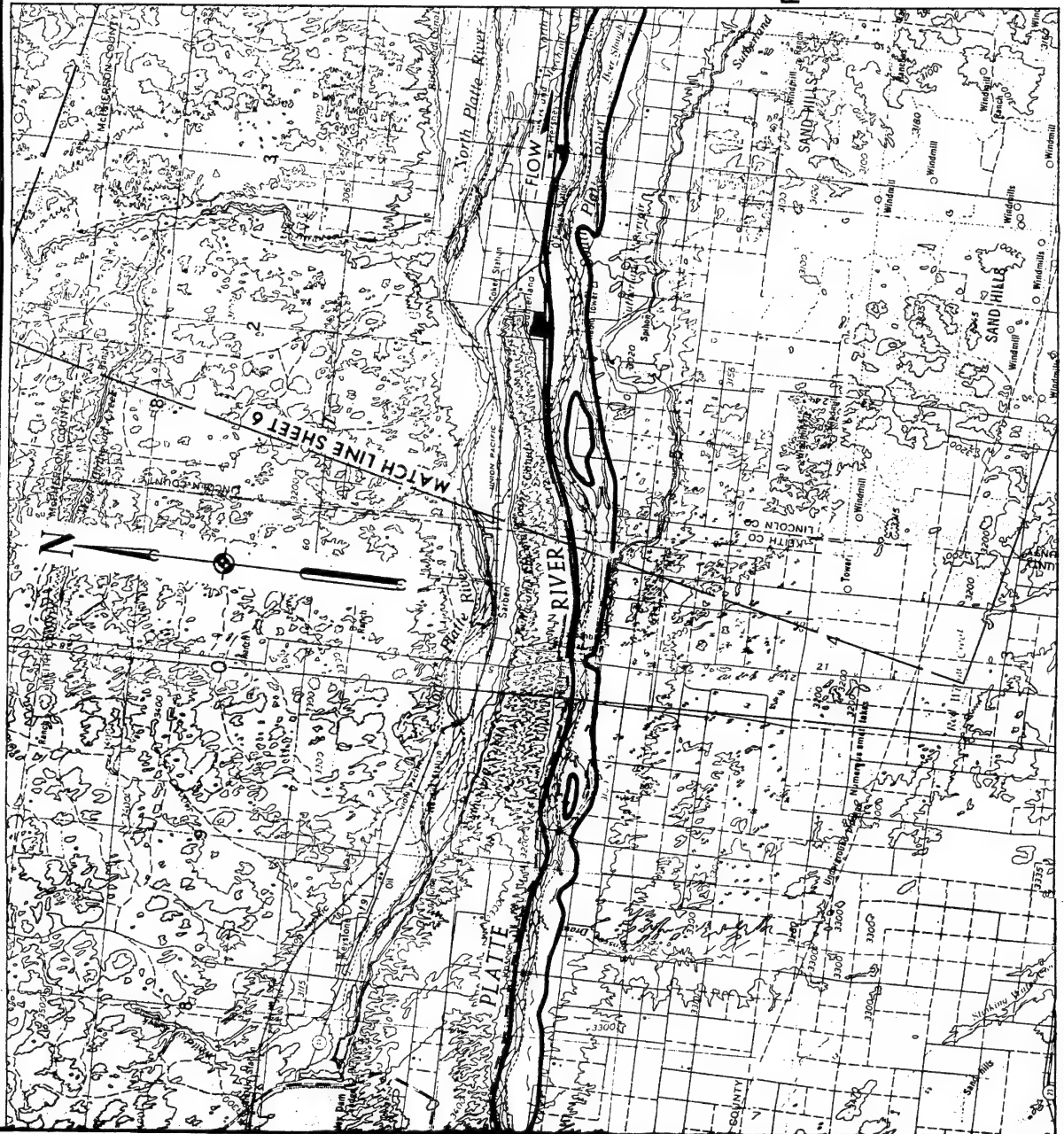
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967
SHEET 4 OF 7

2

APPENDIX I PLATE 5







LEGEND

1965 Flood Outline

NOTE:

1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965

FLOOD OUTLINE OF SOUTH PLATTE RIVER AND TRIBUTARIES
BIG SPRINGS, NEBR. TO SUTHERLAND, NEBR.

SCALE IN MILES



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 5 OF 7

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LEGEND

1965 Flood Outline

NOTE:

- 1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

REPORT ON THE FLOODS OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER
AND TRIBUTARIES
SUTHERLAND, NEBR. TO GOTHENBURG, NEBR.

SCALE IN MILES



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 6 OF 7

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LEGEND

1965 Flood Outline



NOTE:

- 1. See index map (APPENDIX I PLATE 1) for location.

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

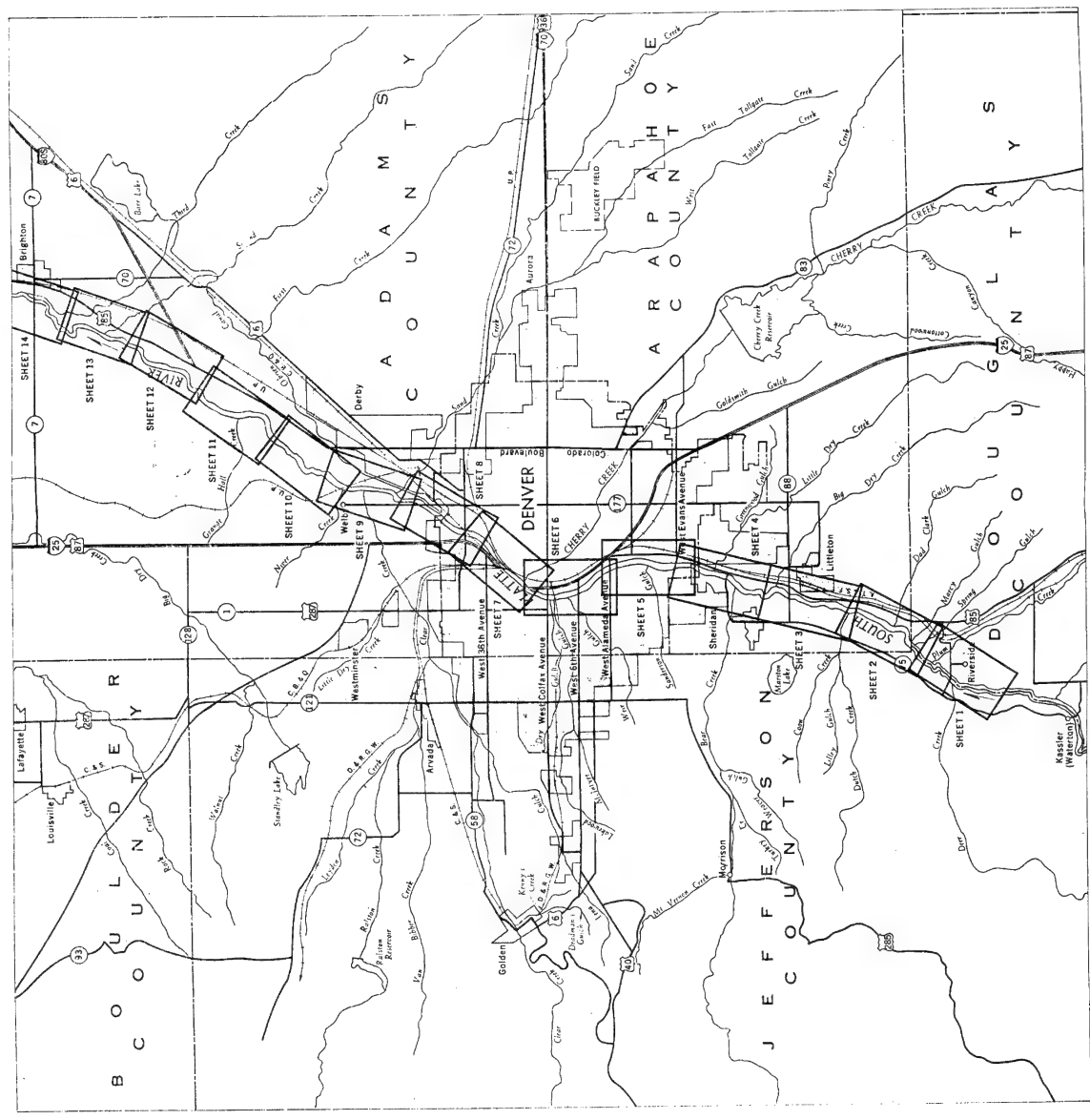
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FLOOD OUTLINE OF SOUTH PLATTE RIVER
AND TRIBUTARIES
BIJOU CREEK—DEERTRAIL, COLO. TO HOYT, COLO.

SCALE IN MILES



U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967





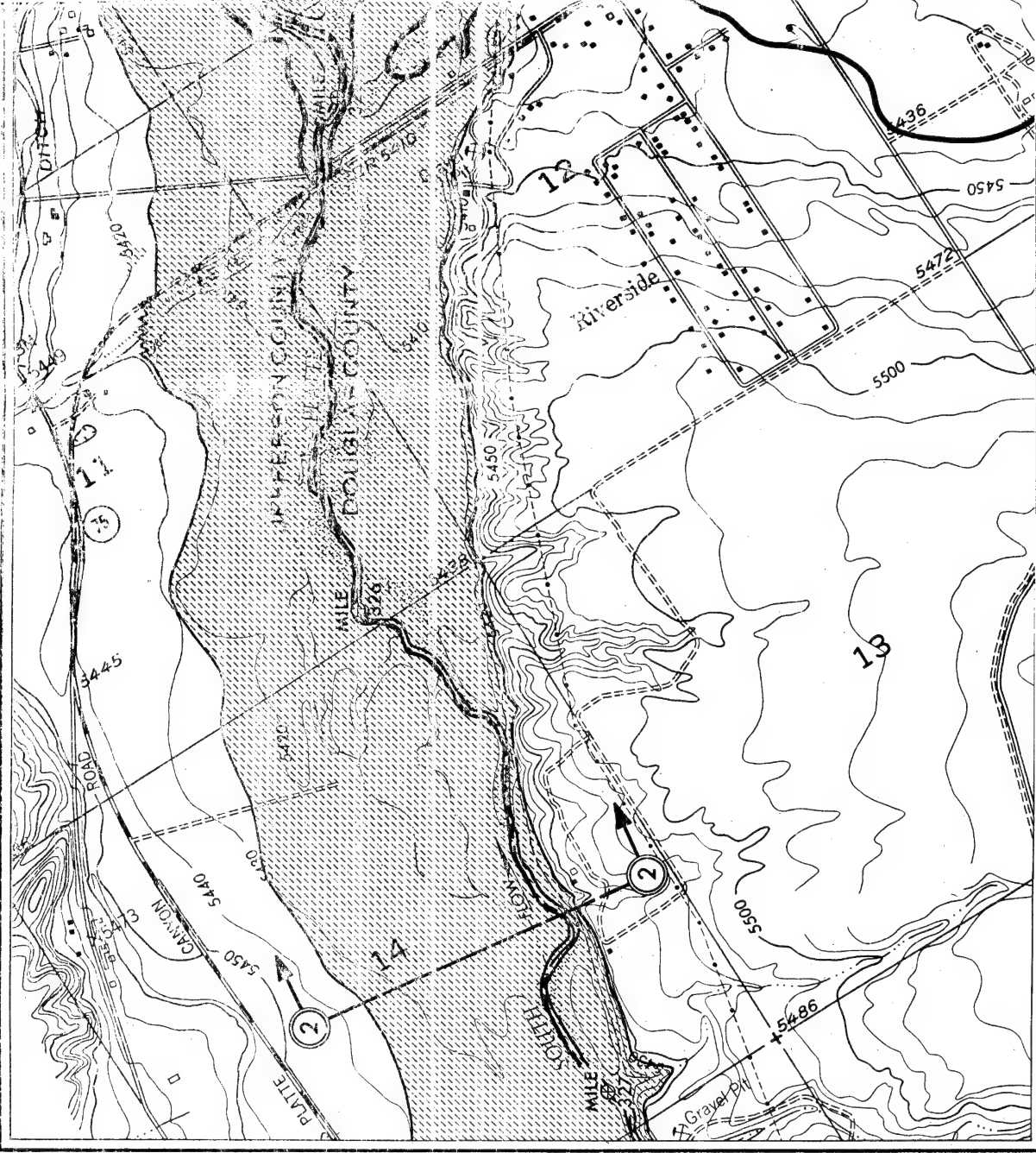
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SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965

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SOUTH PLATTE RIVER, PLUM CREEK
CONFLUENCE TO BRIGHTON, COLO.
OF THE FLOOD OF JUNE 1965
CORPS OF ENGINEERS, CIVIL ENGINEERING
JANUARY 1967

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LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

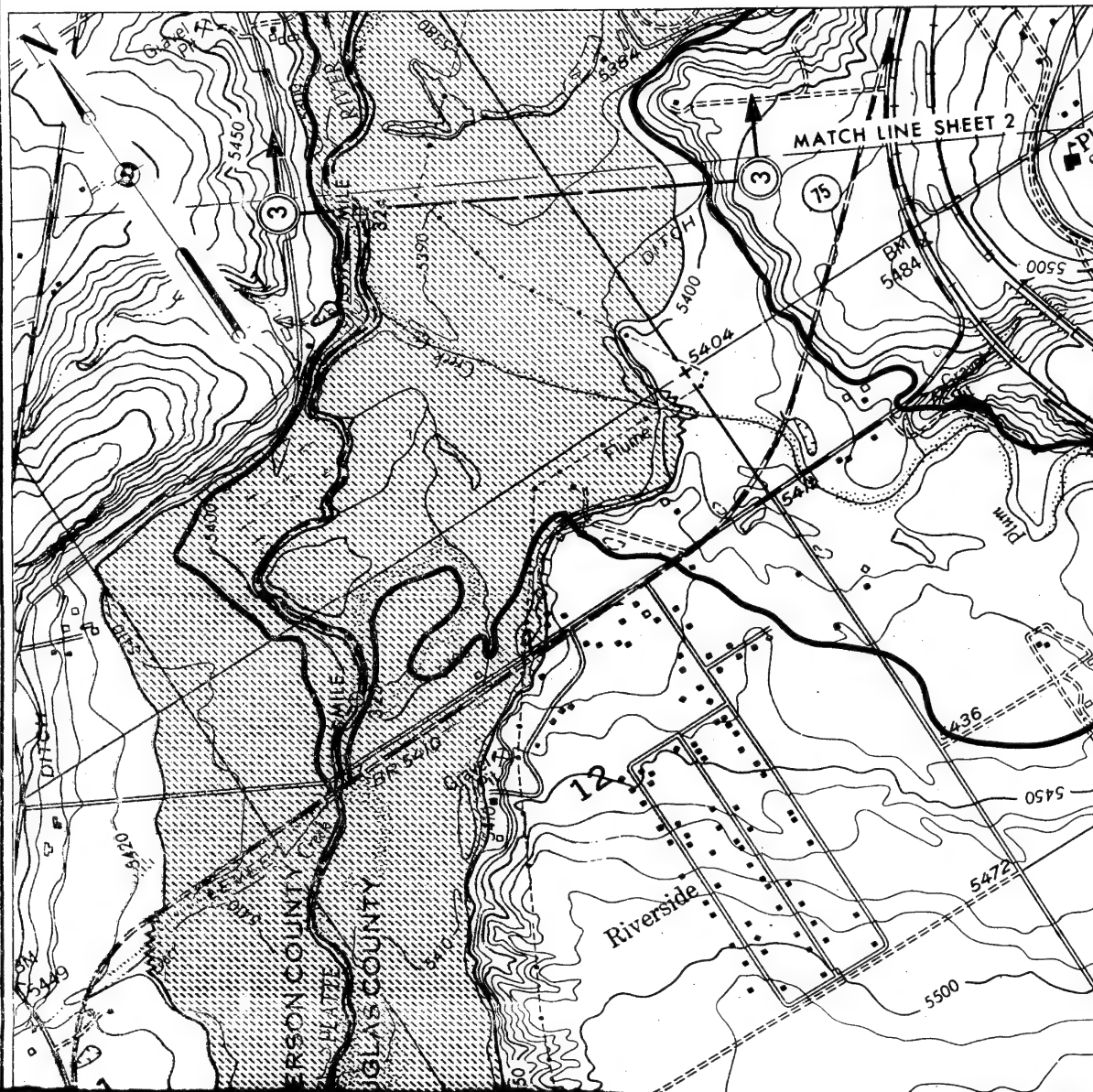
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

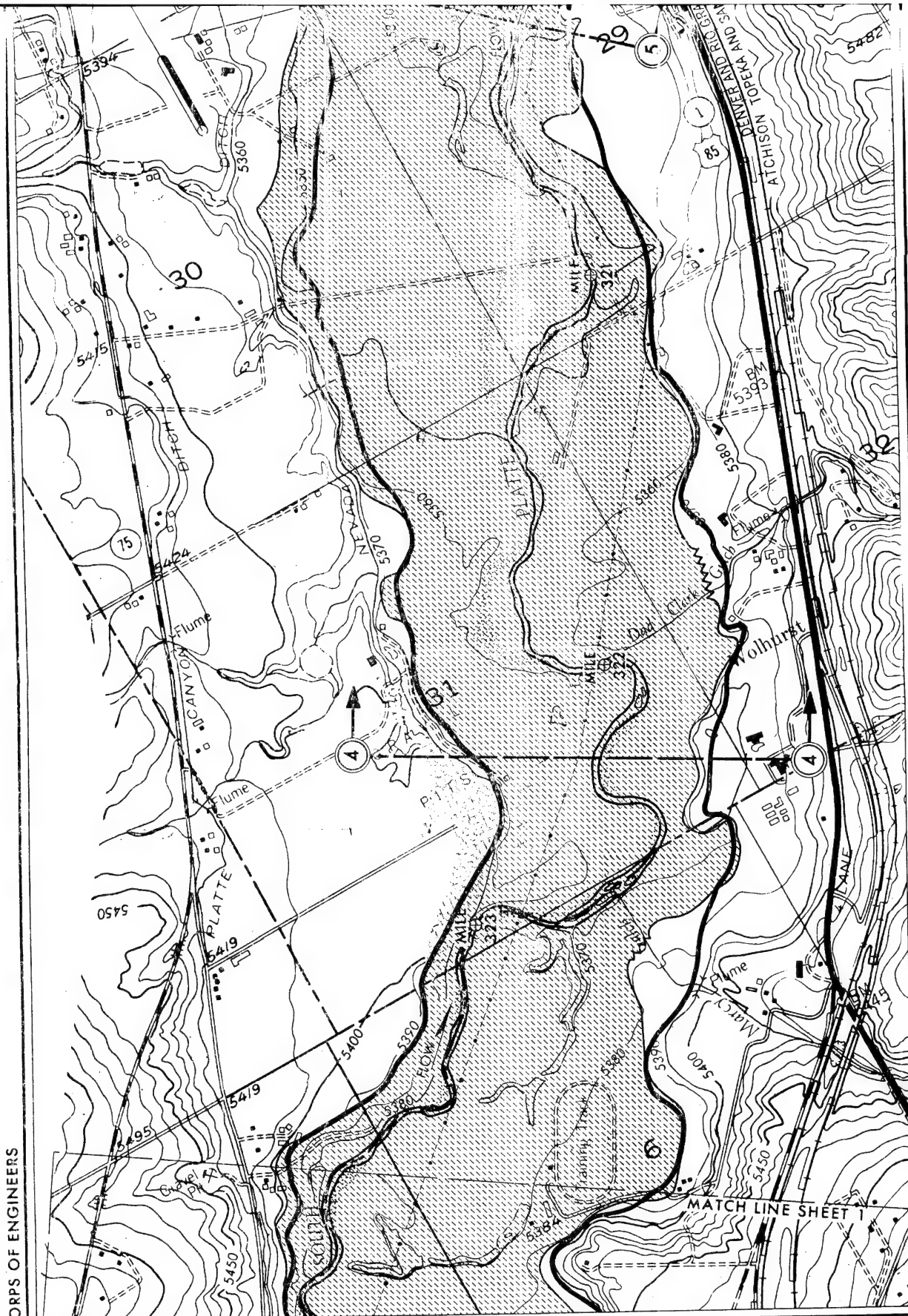
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



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CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 1 OF 14

APPENDIX I PLATE 10

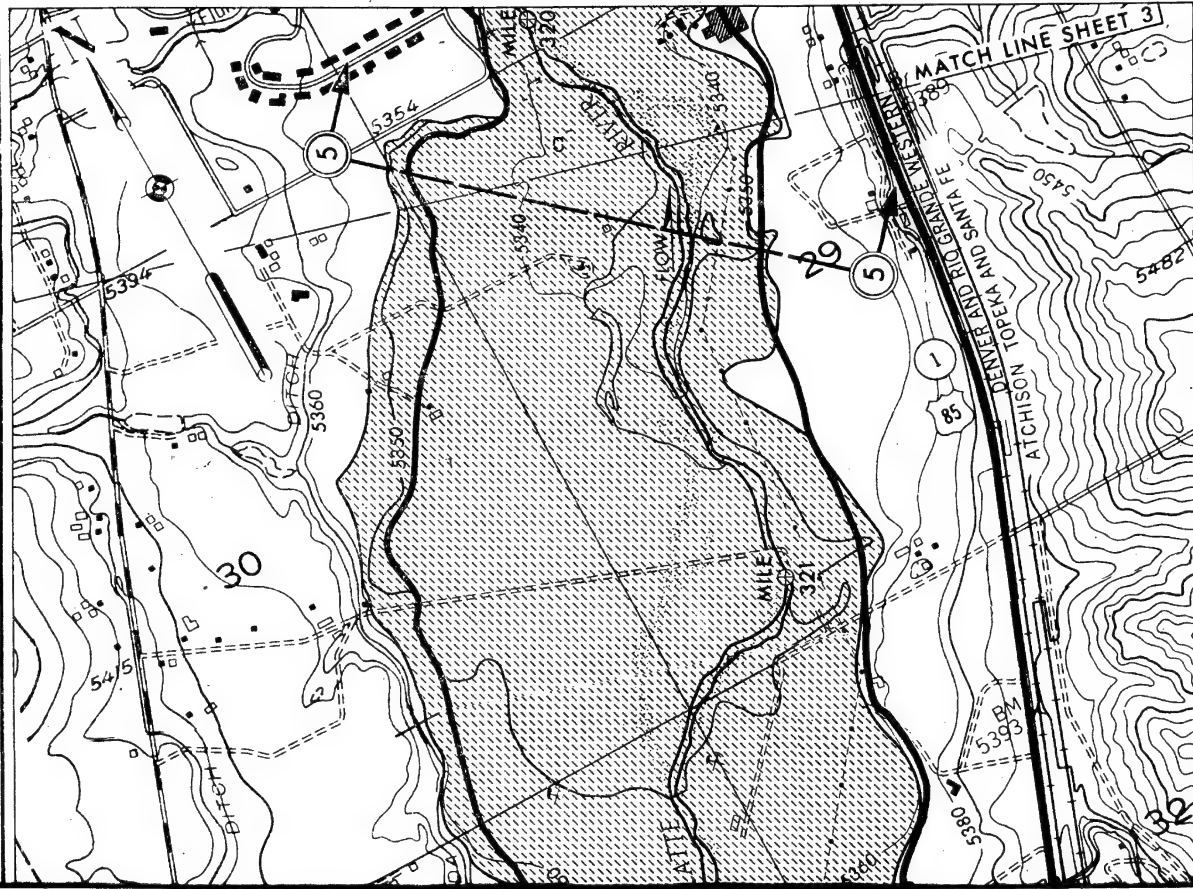




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LEGEND

Area of Indicated Flood Hazard

1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

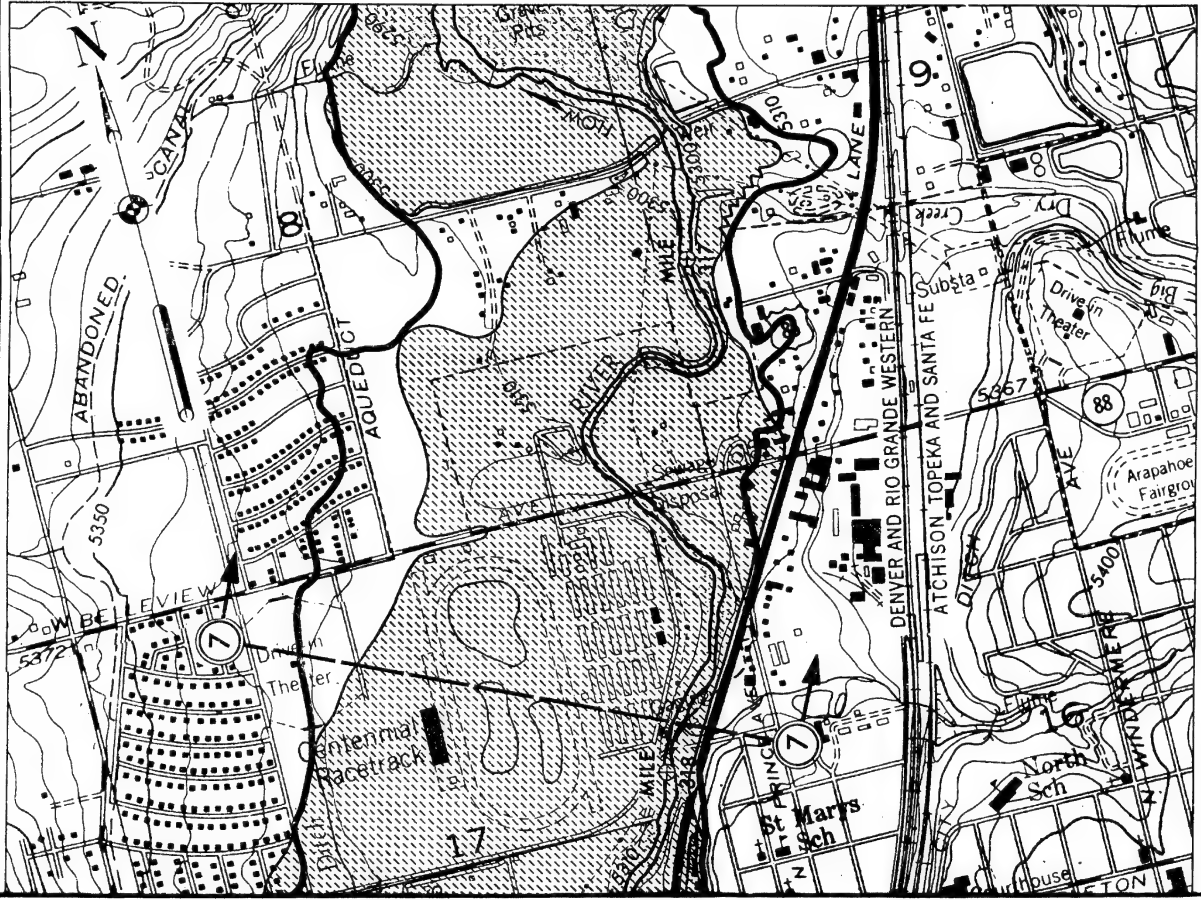
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



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CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 2 OF 14



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LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

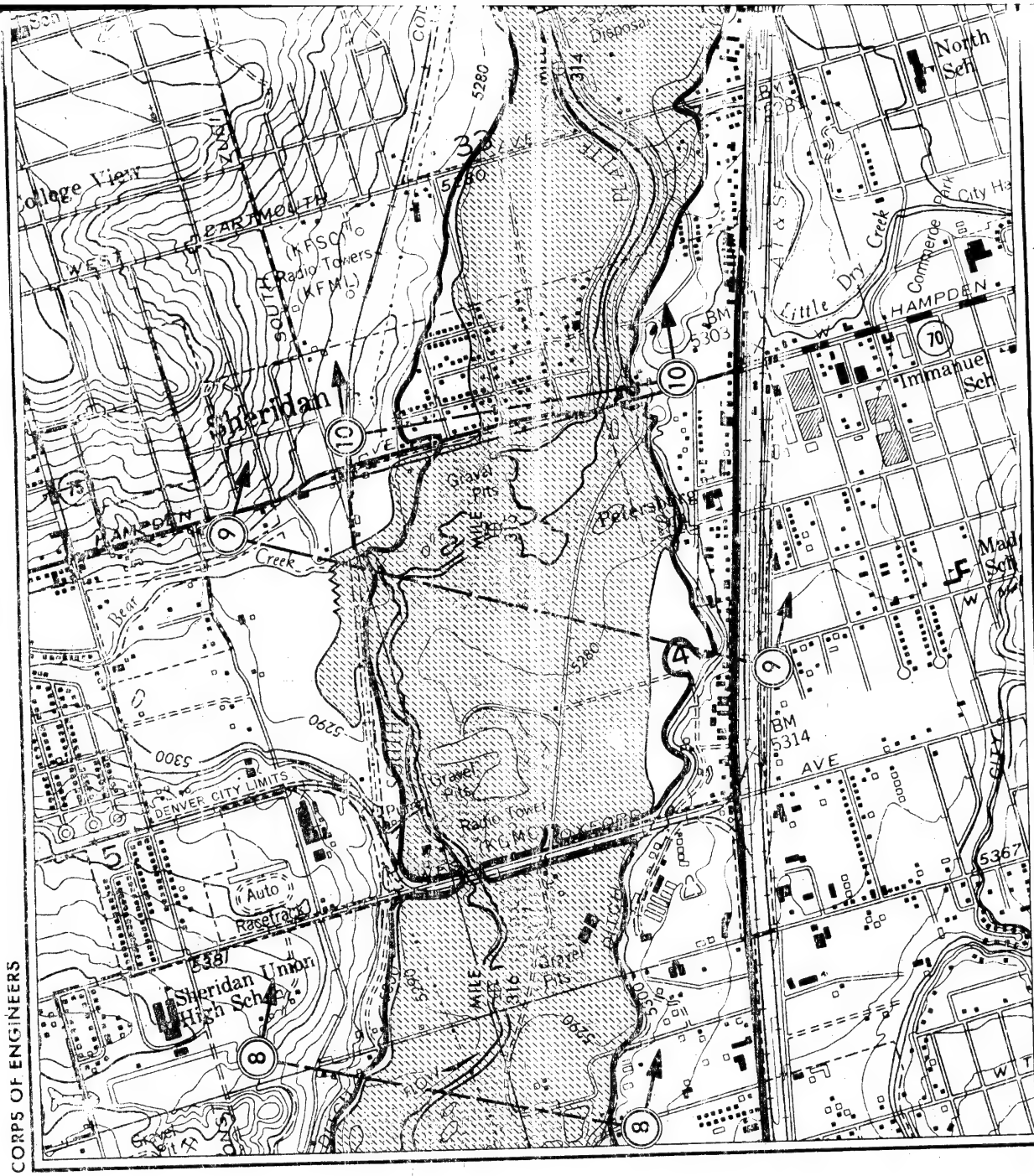
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SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

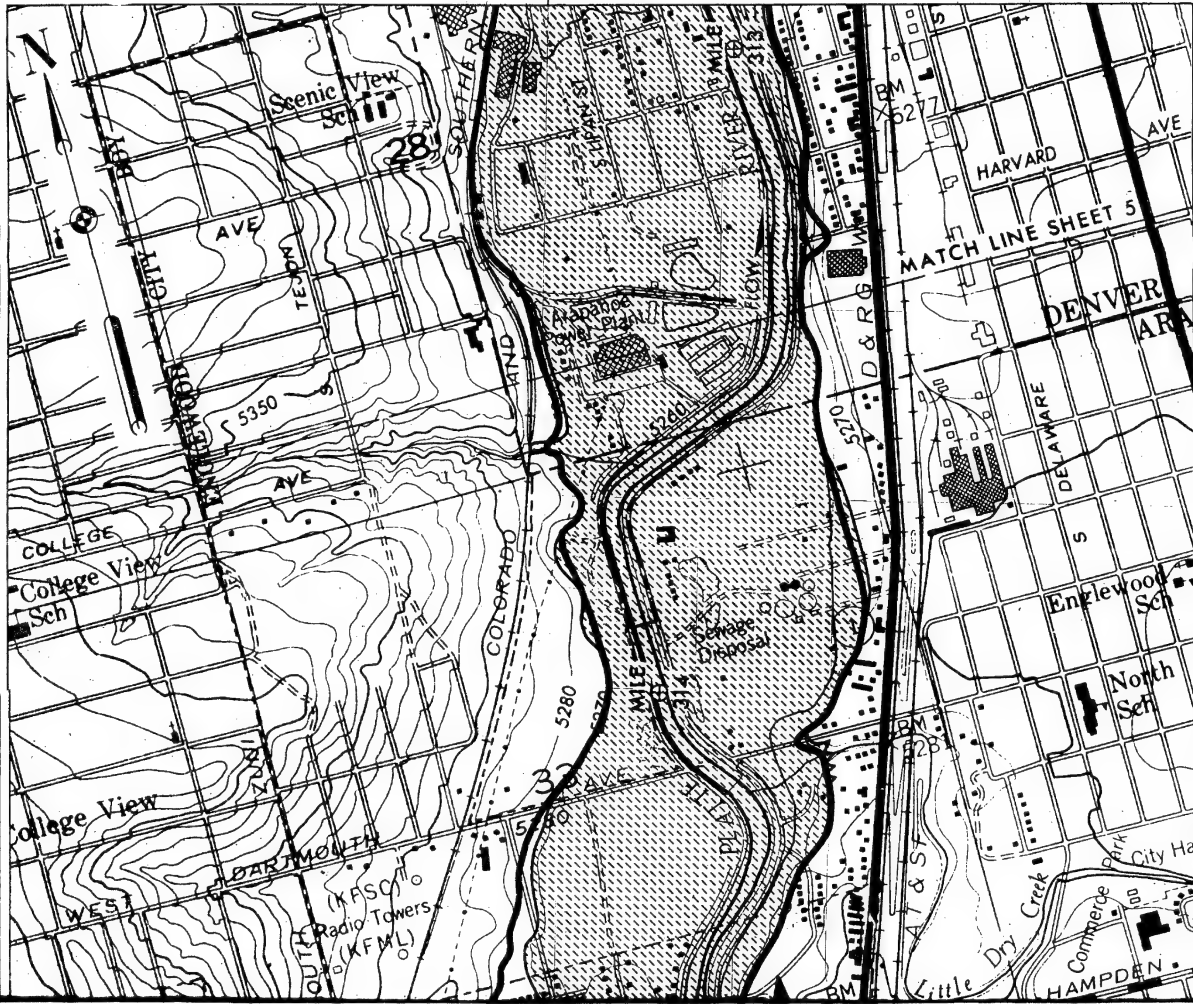
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



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CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 3 OF 14



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LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

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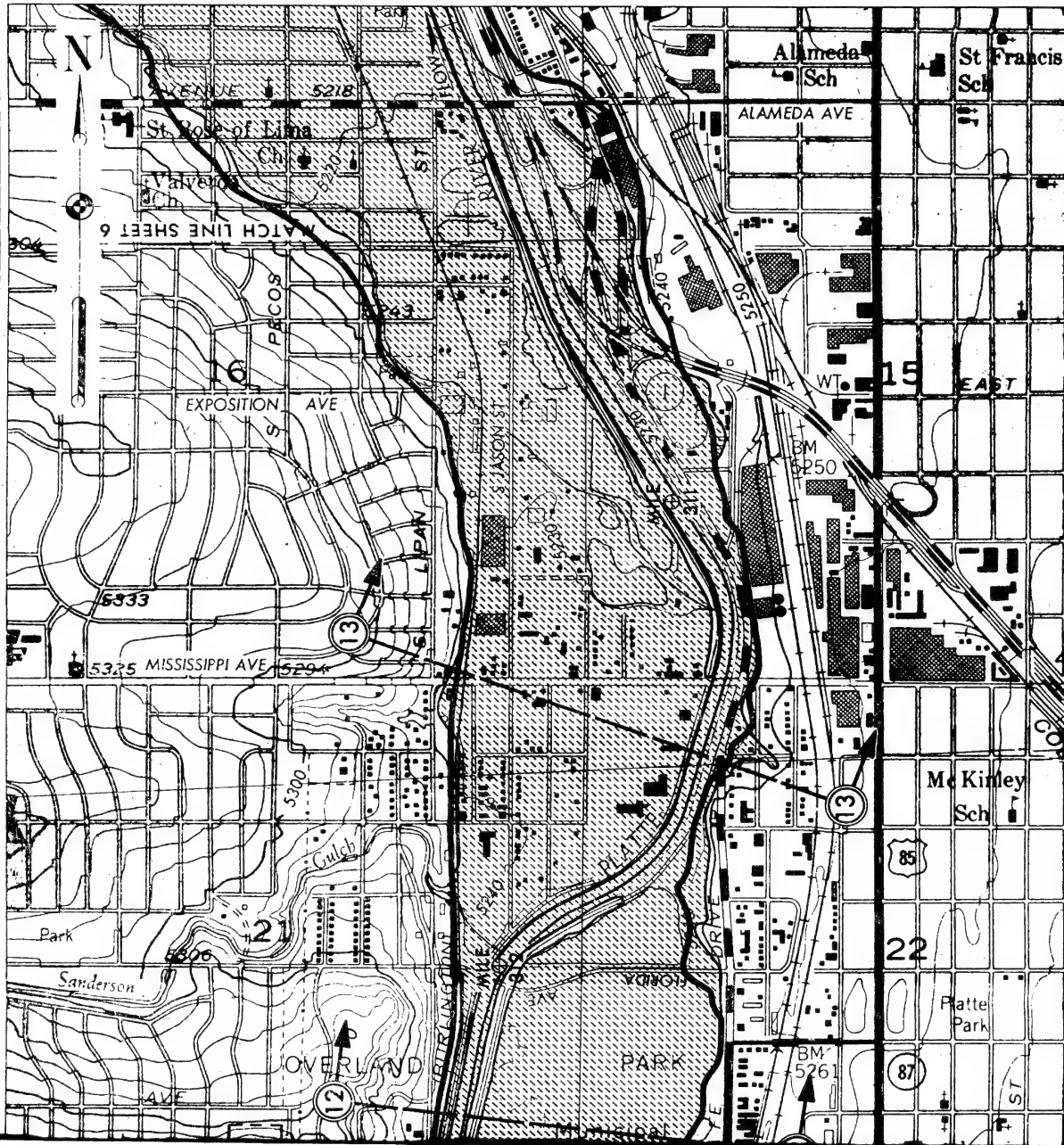
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
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CORPS OF ENGINEERS OMAHA, NEBRASKA
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LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE

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SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 5 OF 14

2



LEGEND

Area of Indicated Flood Hazard

1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

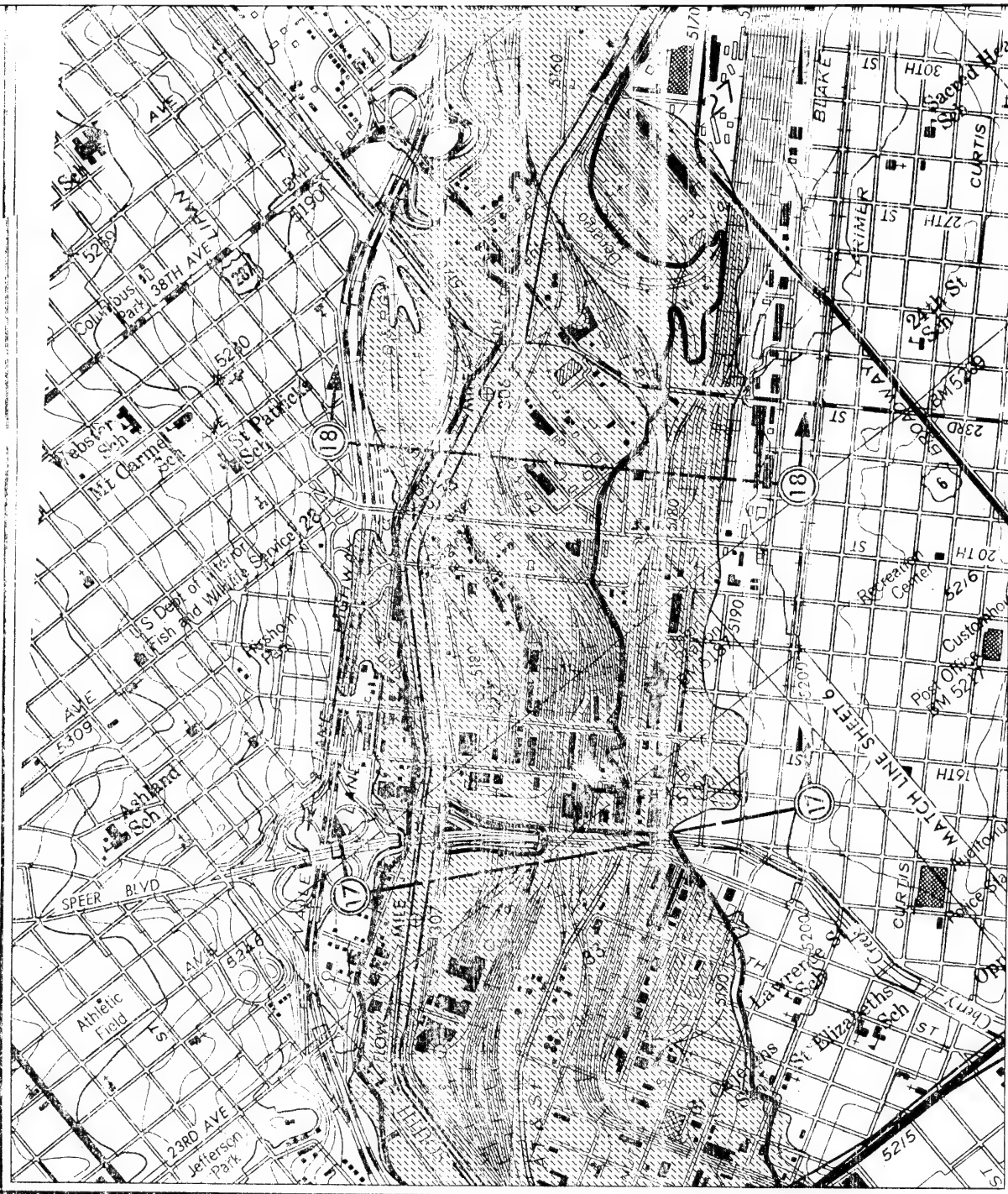
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.

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CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 6 OF 14

2



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LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

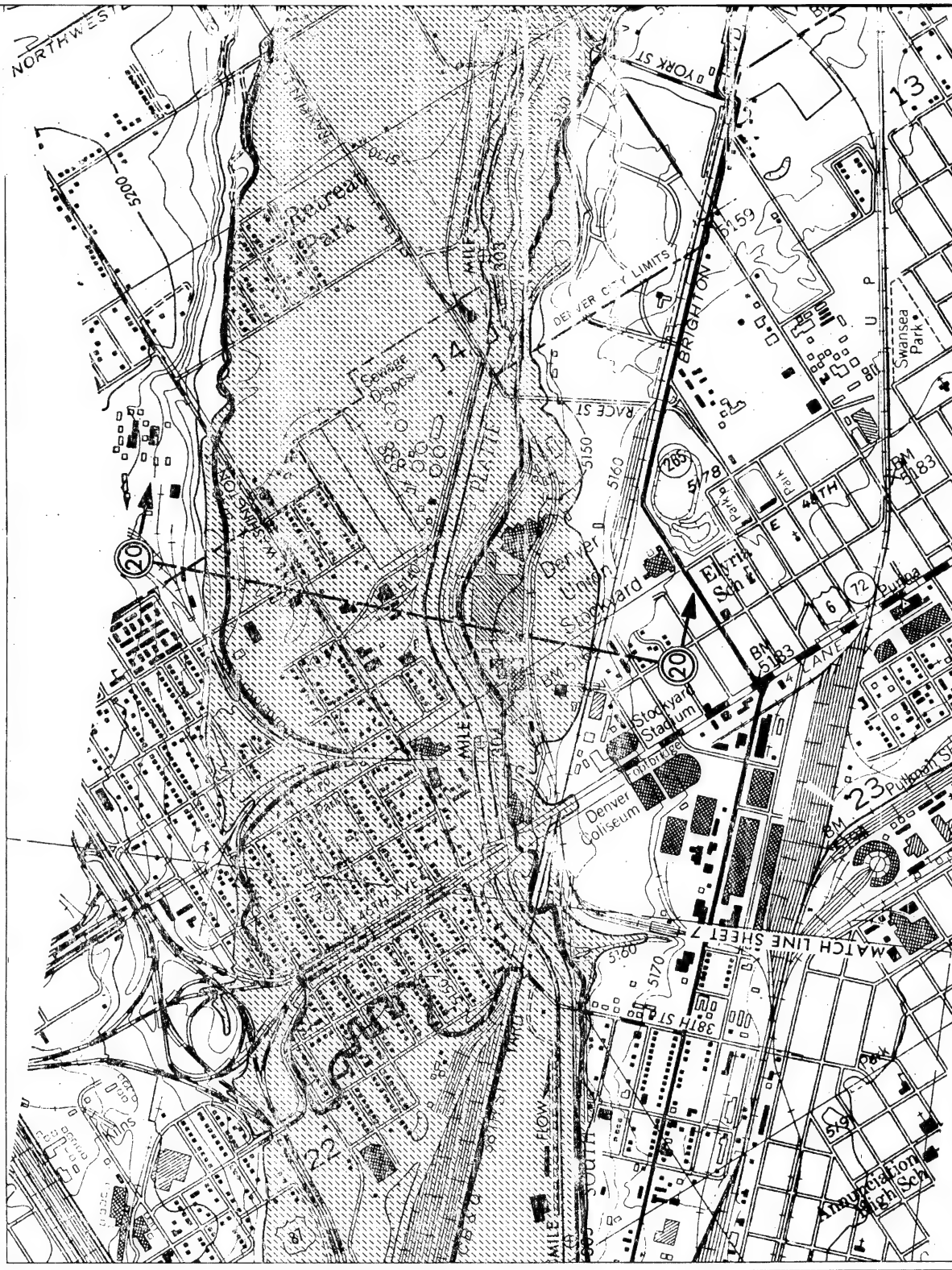
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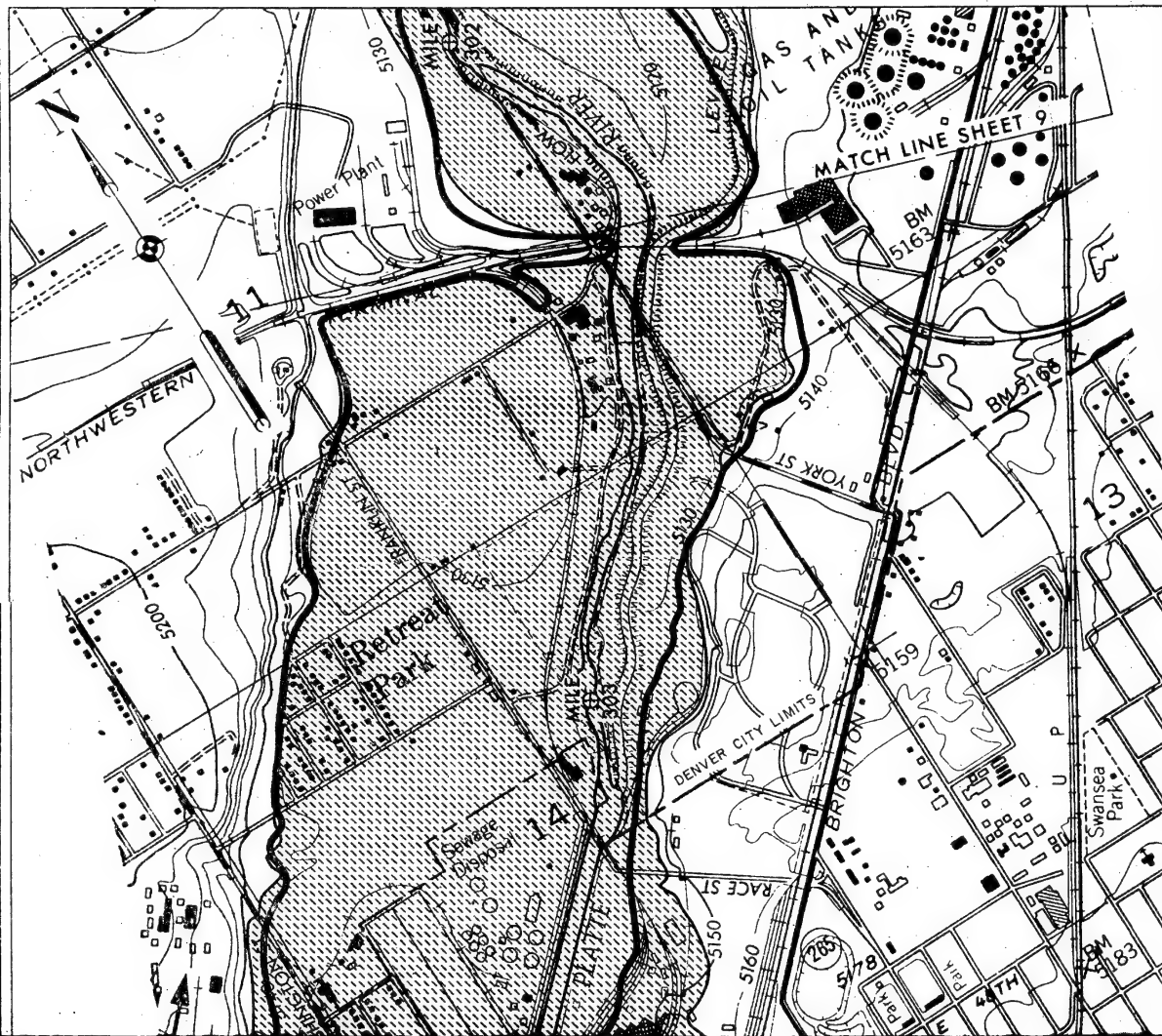
SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



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JANUARY 1967 SHEET 7 OF 14



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LEGEND

-  Area of Indicated Flood Hazard
-  1965 Flood Outline

NOTE:

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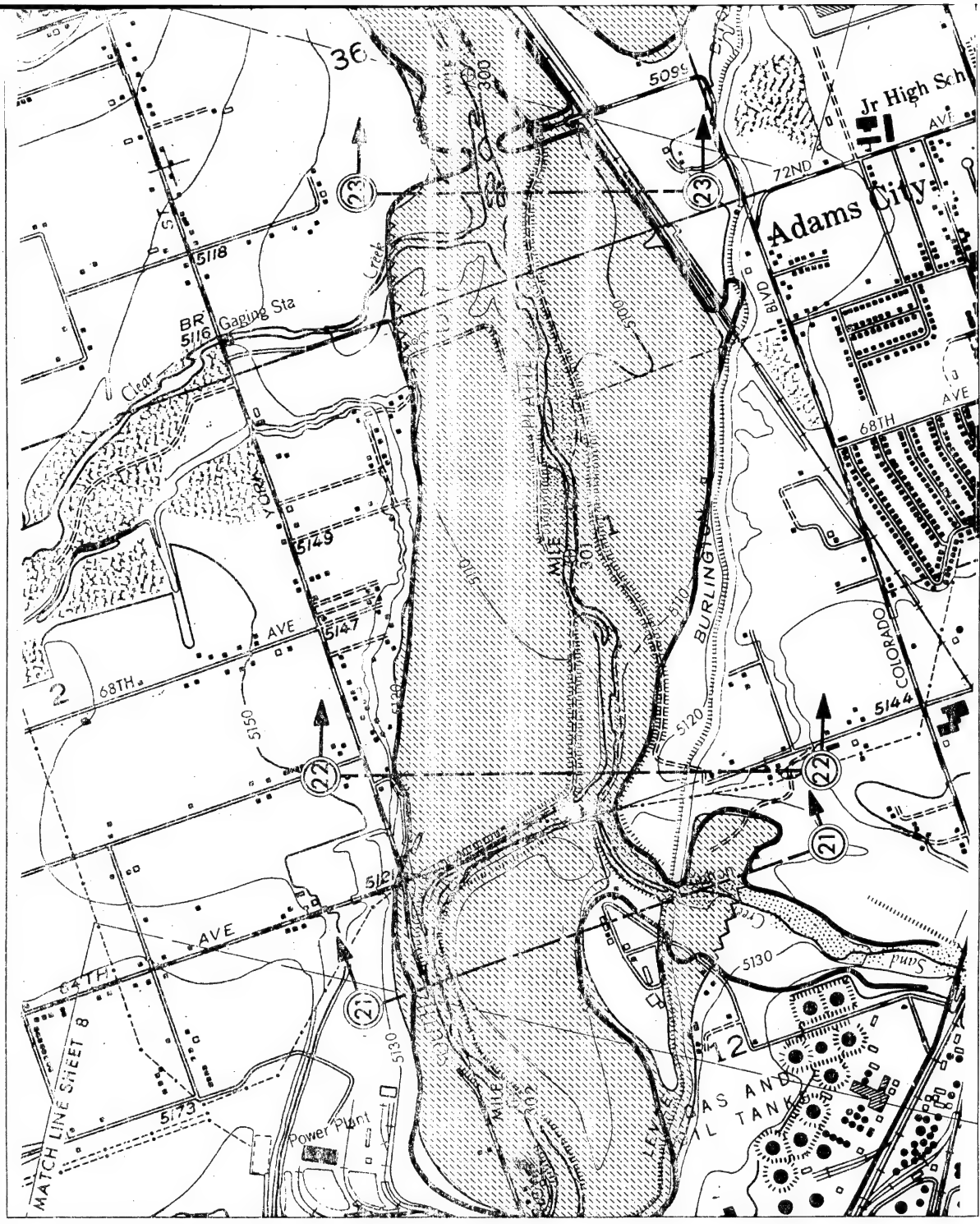
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



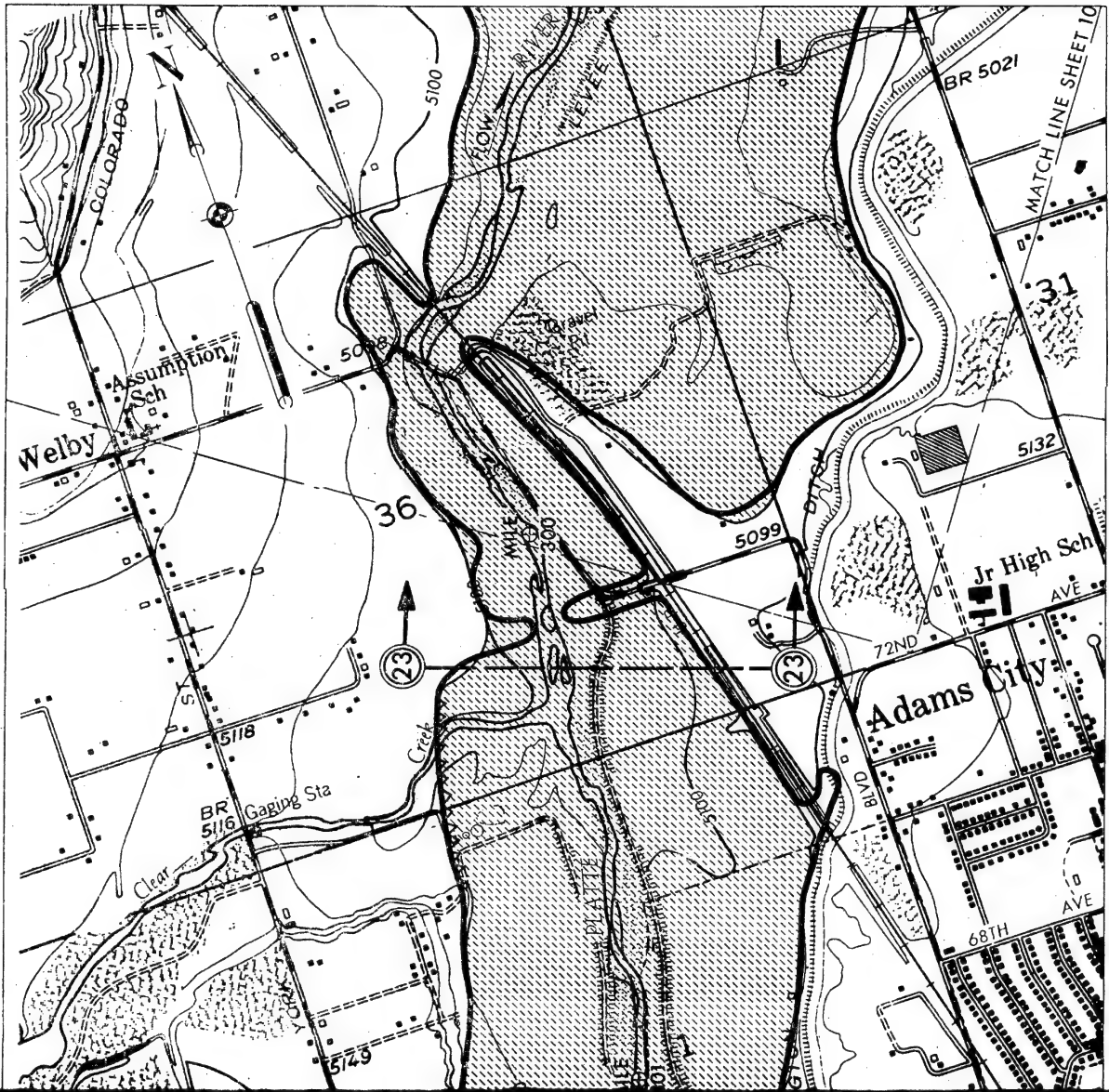
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
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CORPS OF ENGINEERS



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1



LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

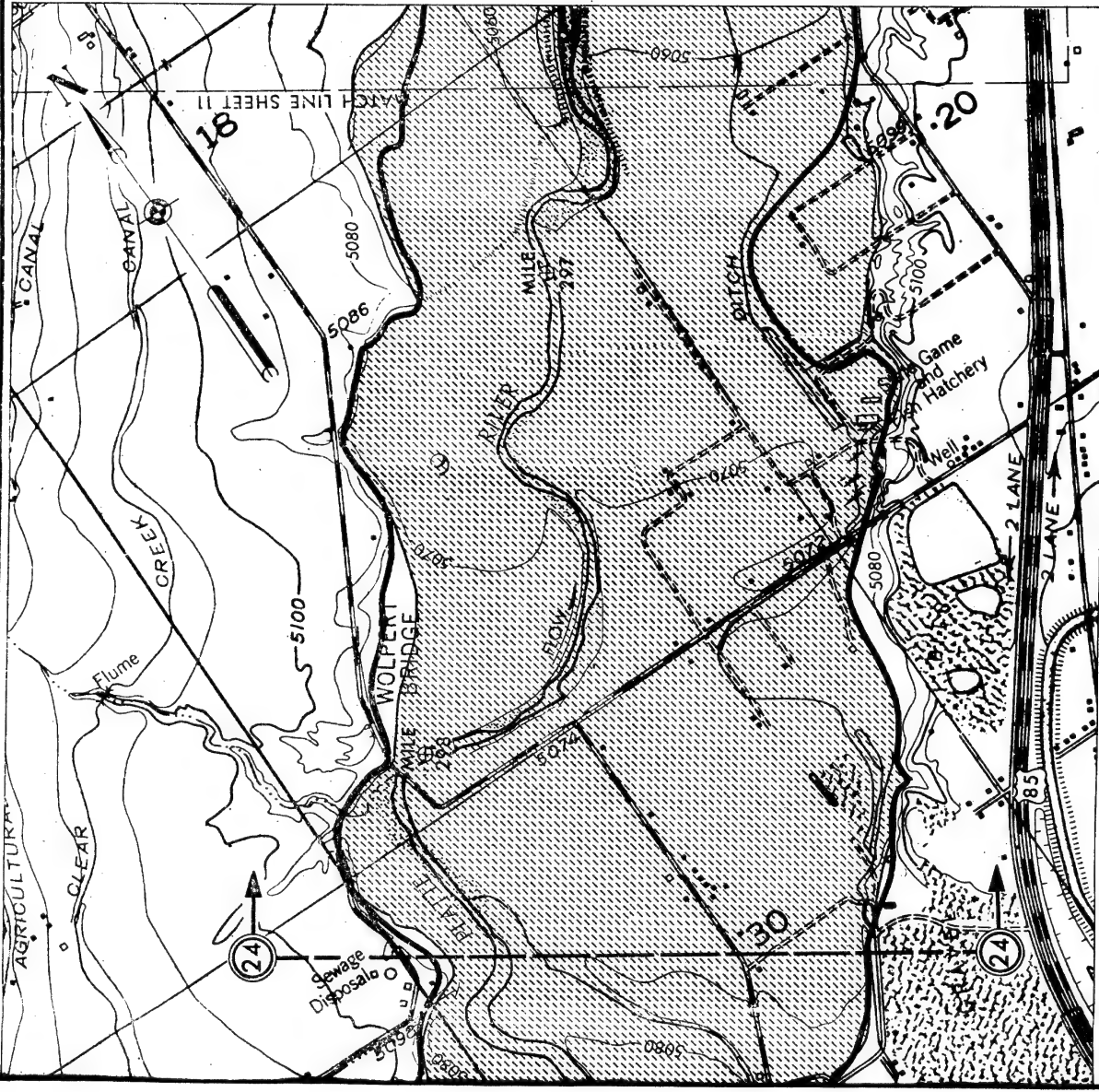
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
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CORPS OF ENGINEERS OMAHA, NEBRASKA
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Topography reproduced from 1937 U.S.G.S. quadrangles, Brighton, Colo., and Fort Lupton, Colo.



LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

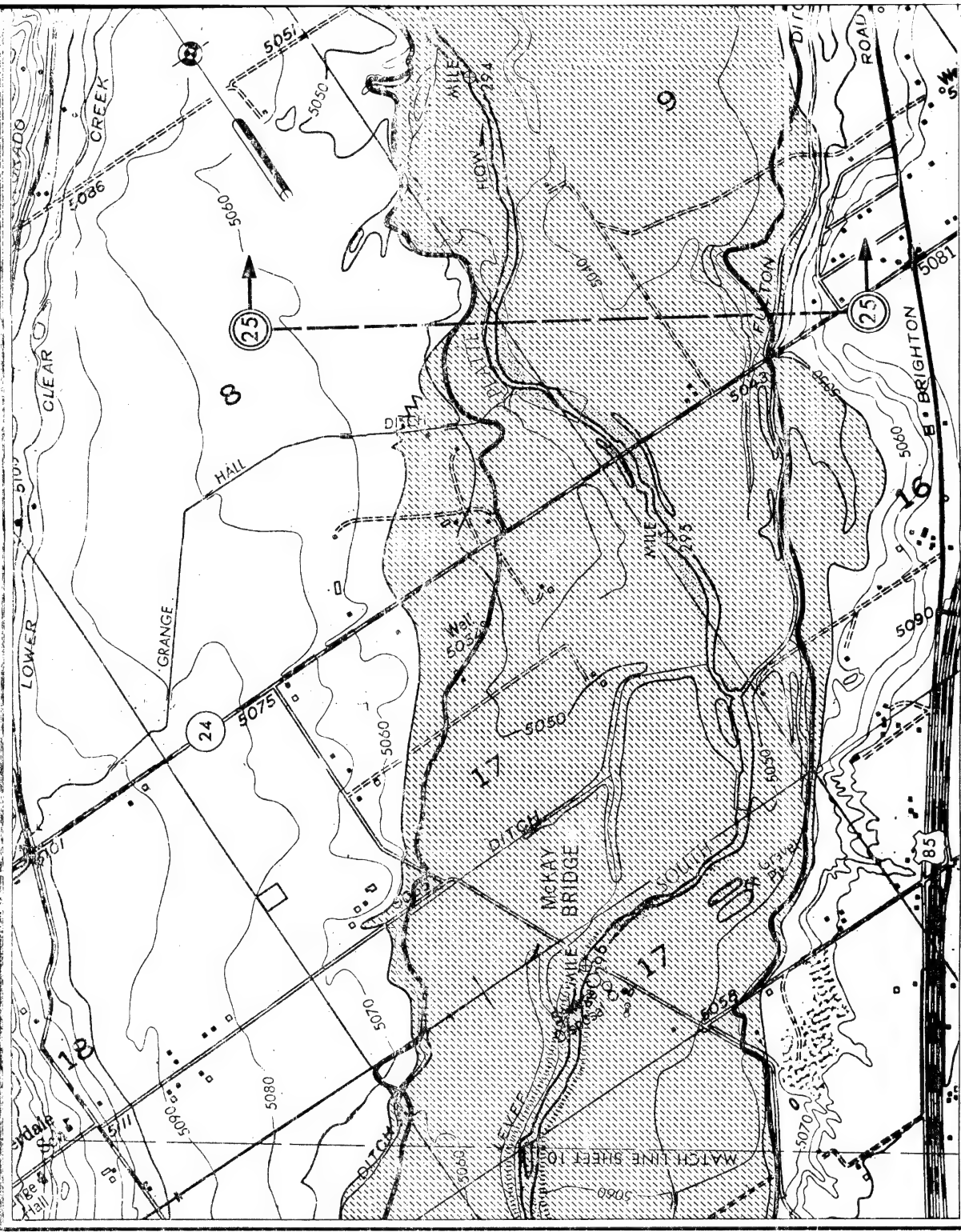
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SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

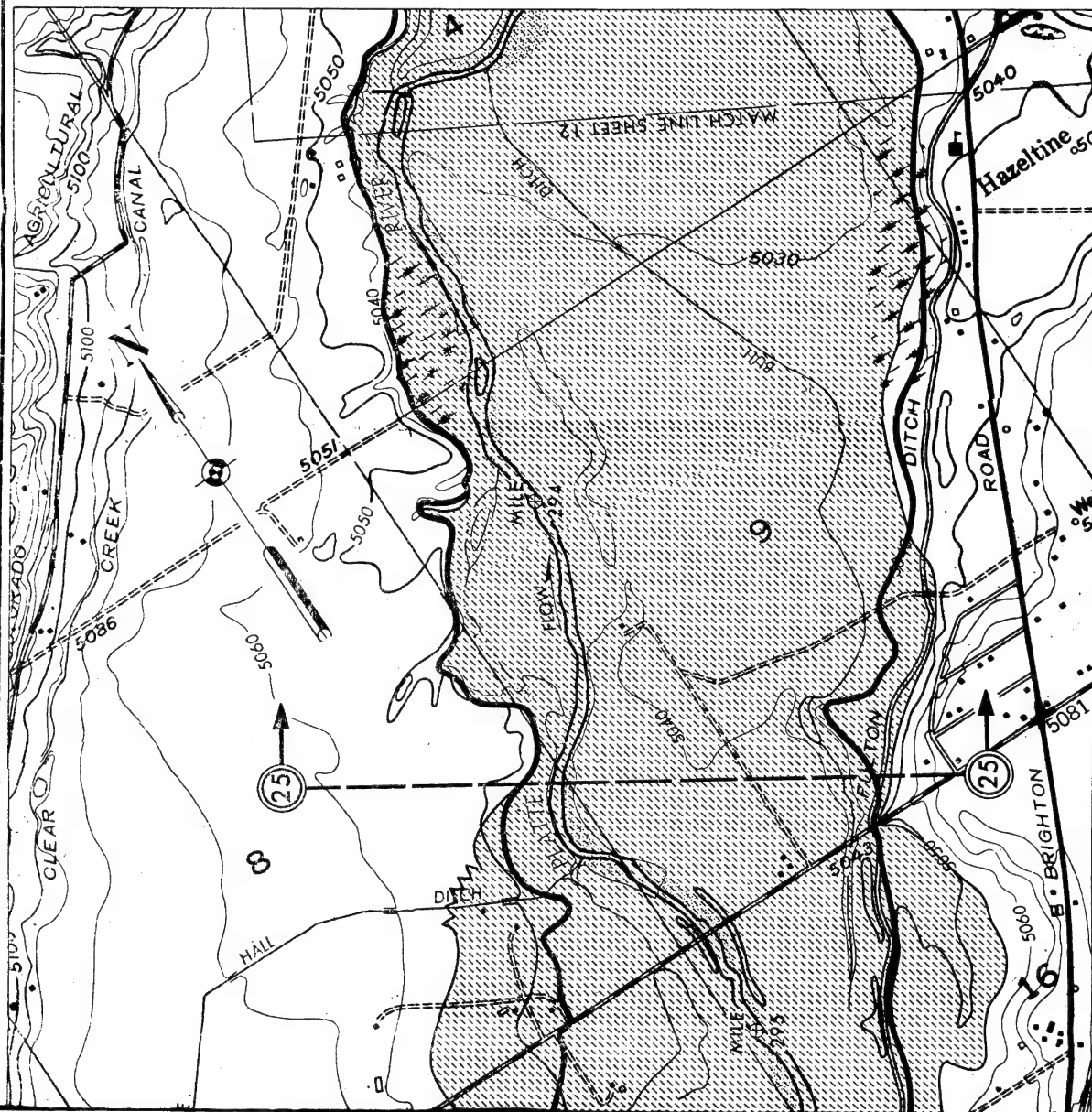
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
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CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 10 OF 14



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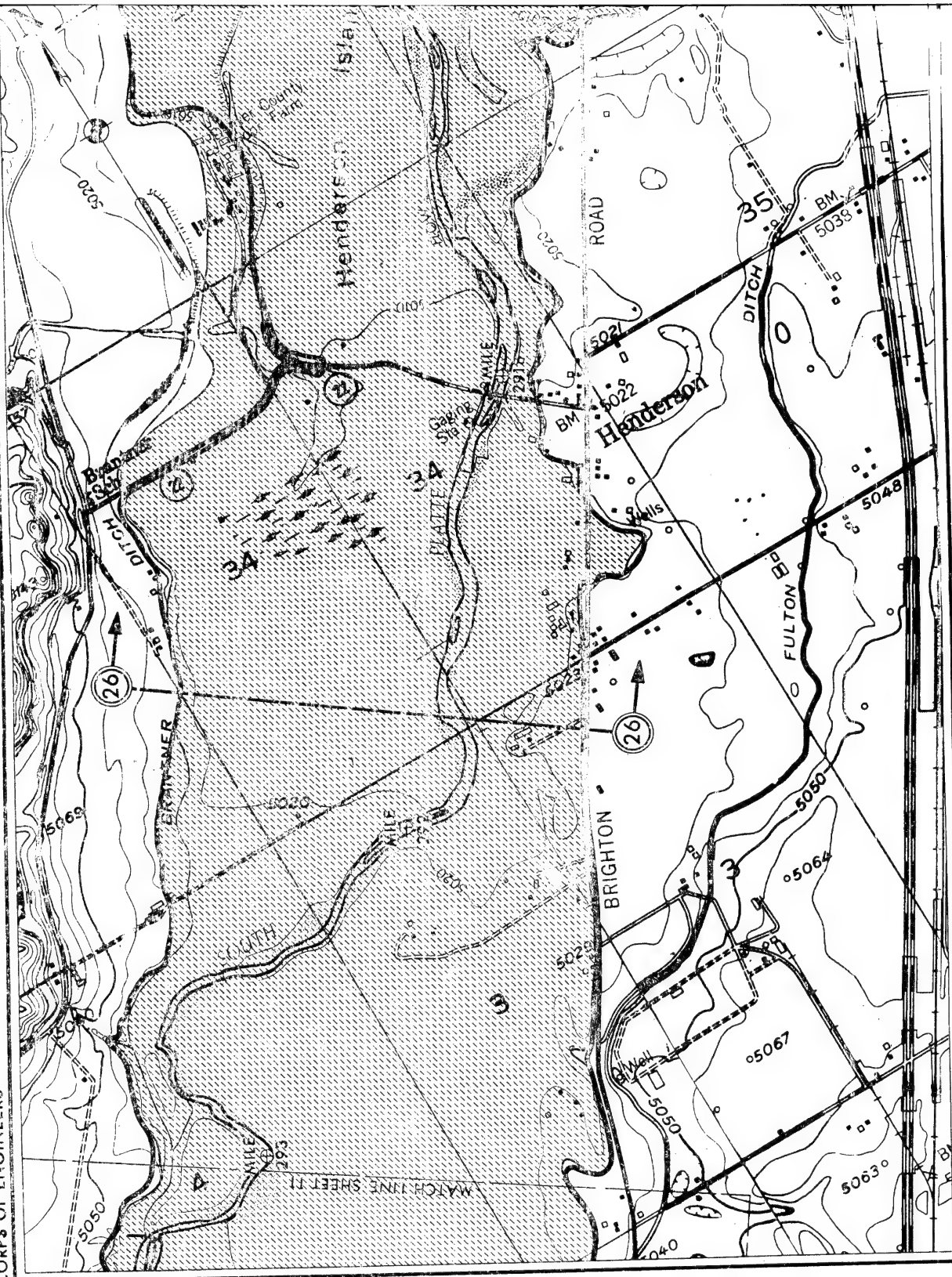
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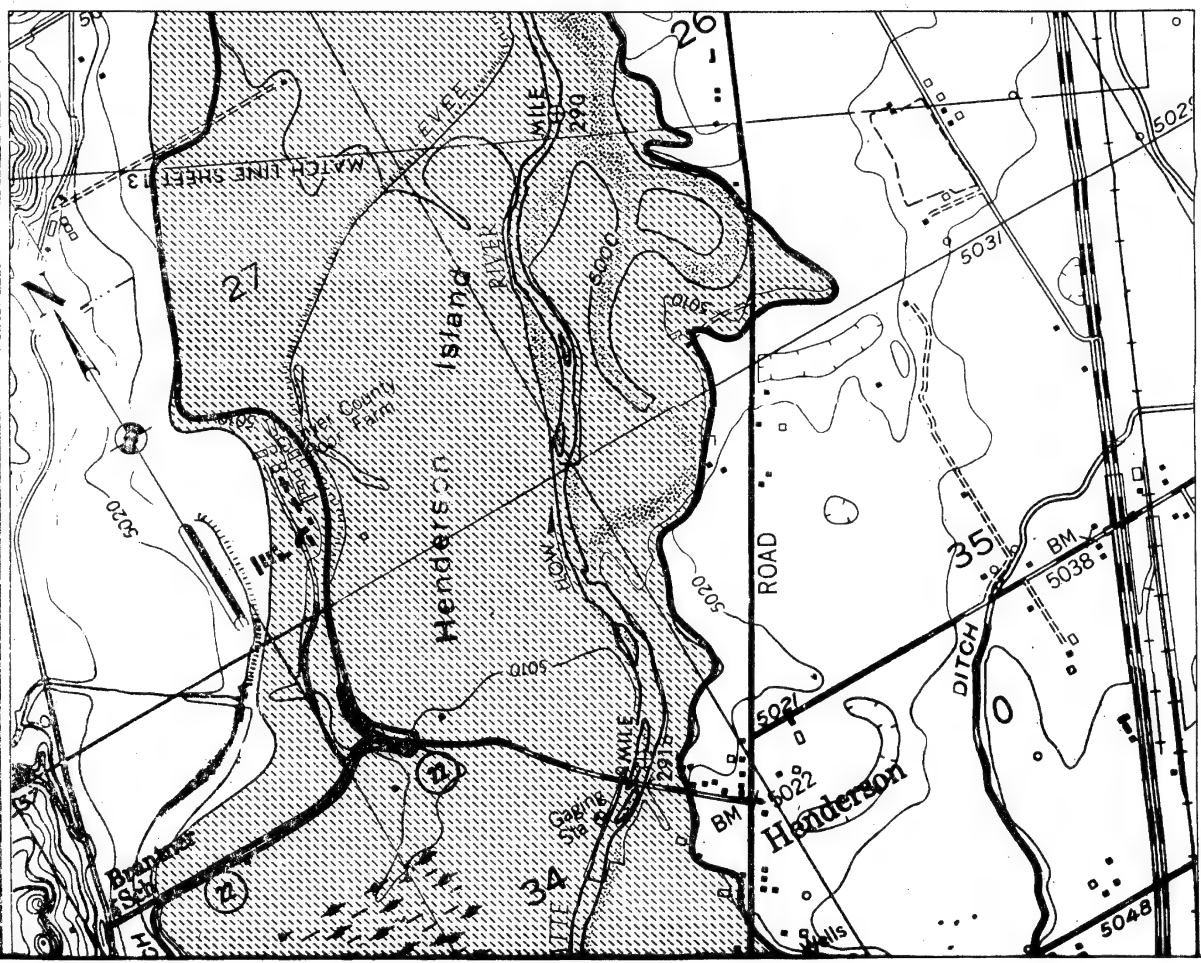
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 11 OF 14





LEGEND



Area of indicated Flood Hazard



1965 Flood Outline

NOTE:

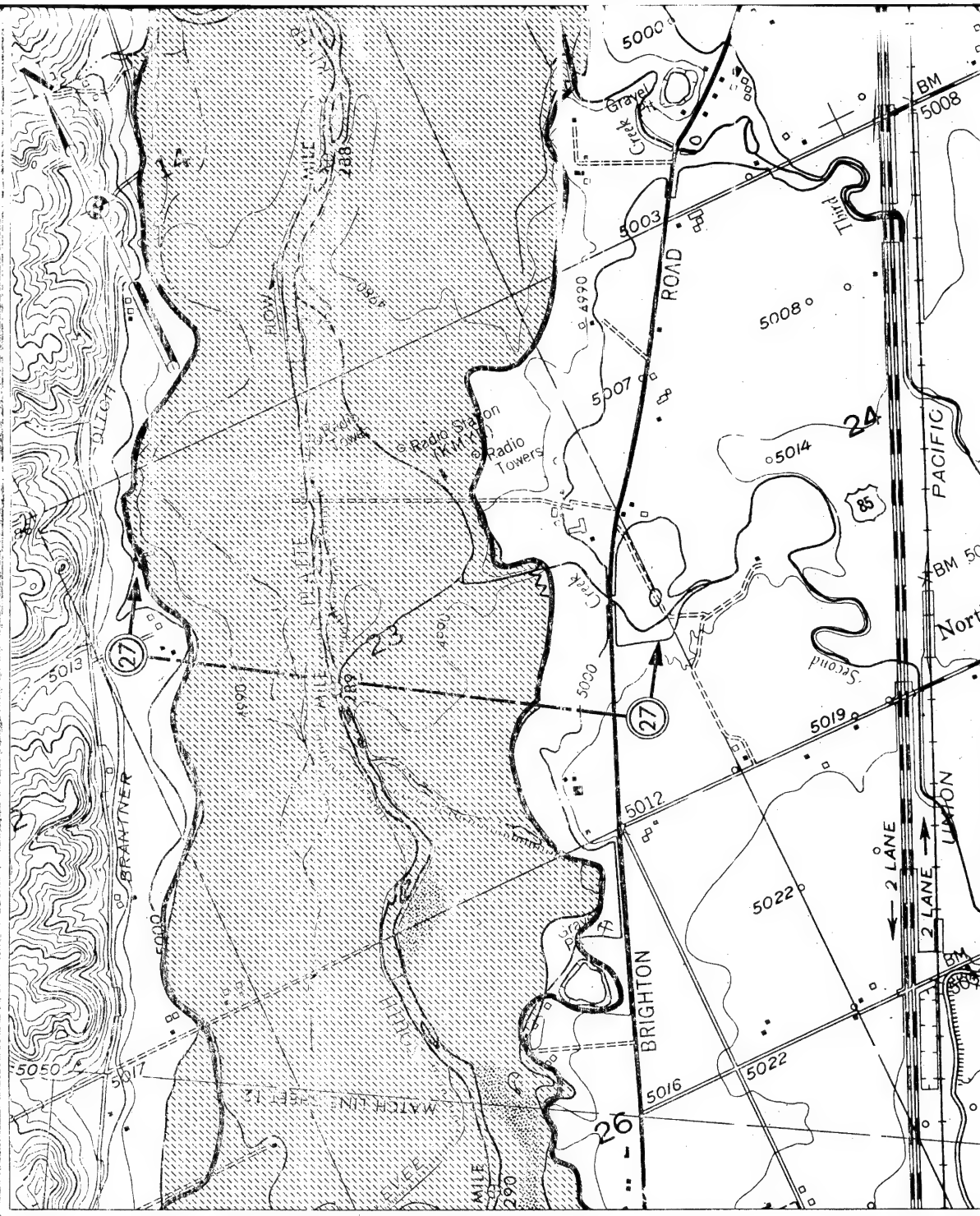
1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

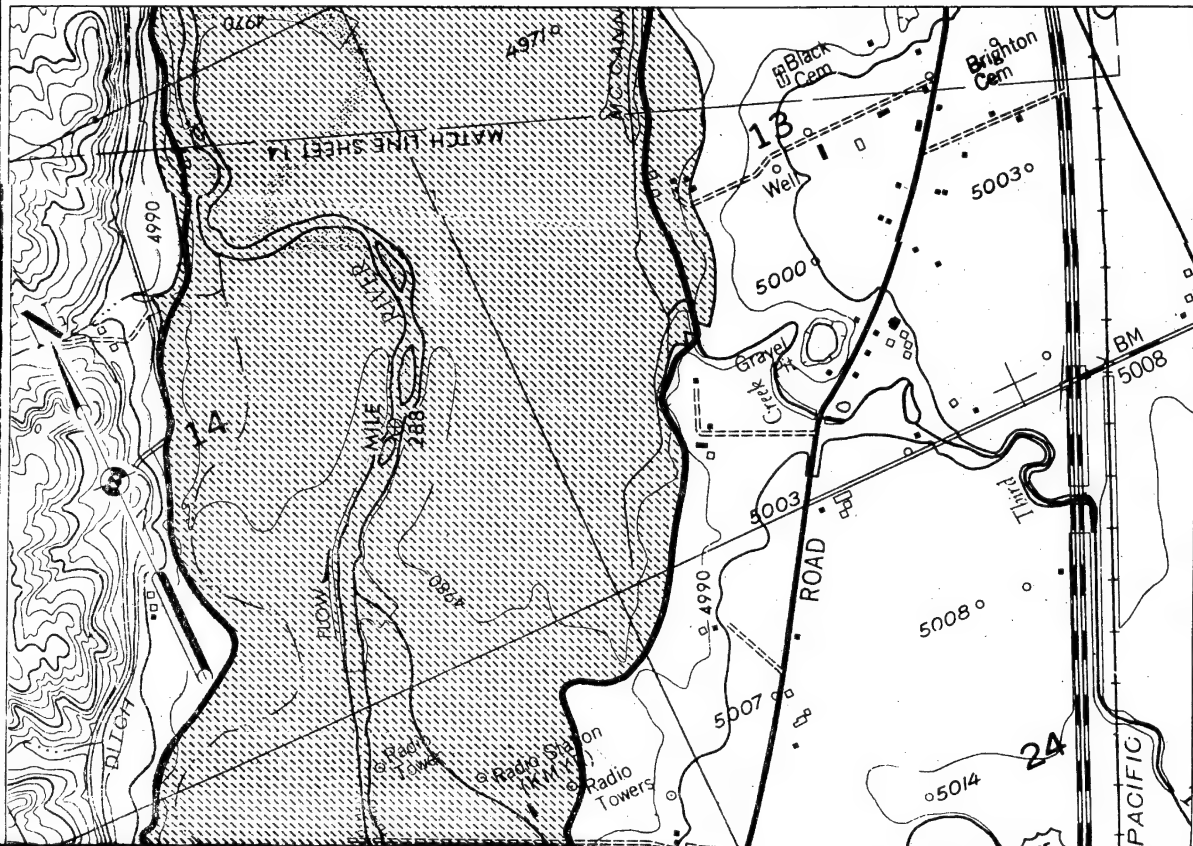
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 12 OF 14





LEGEND

-  Area of Indicated Flood Hazard
-  1965 Flood Outline

NOTE:

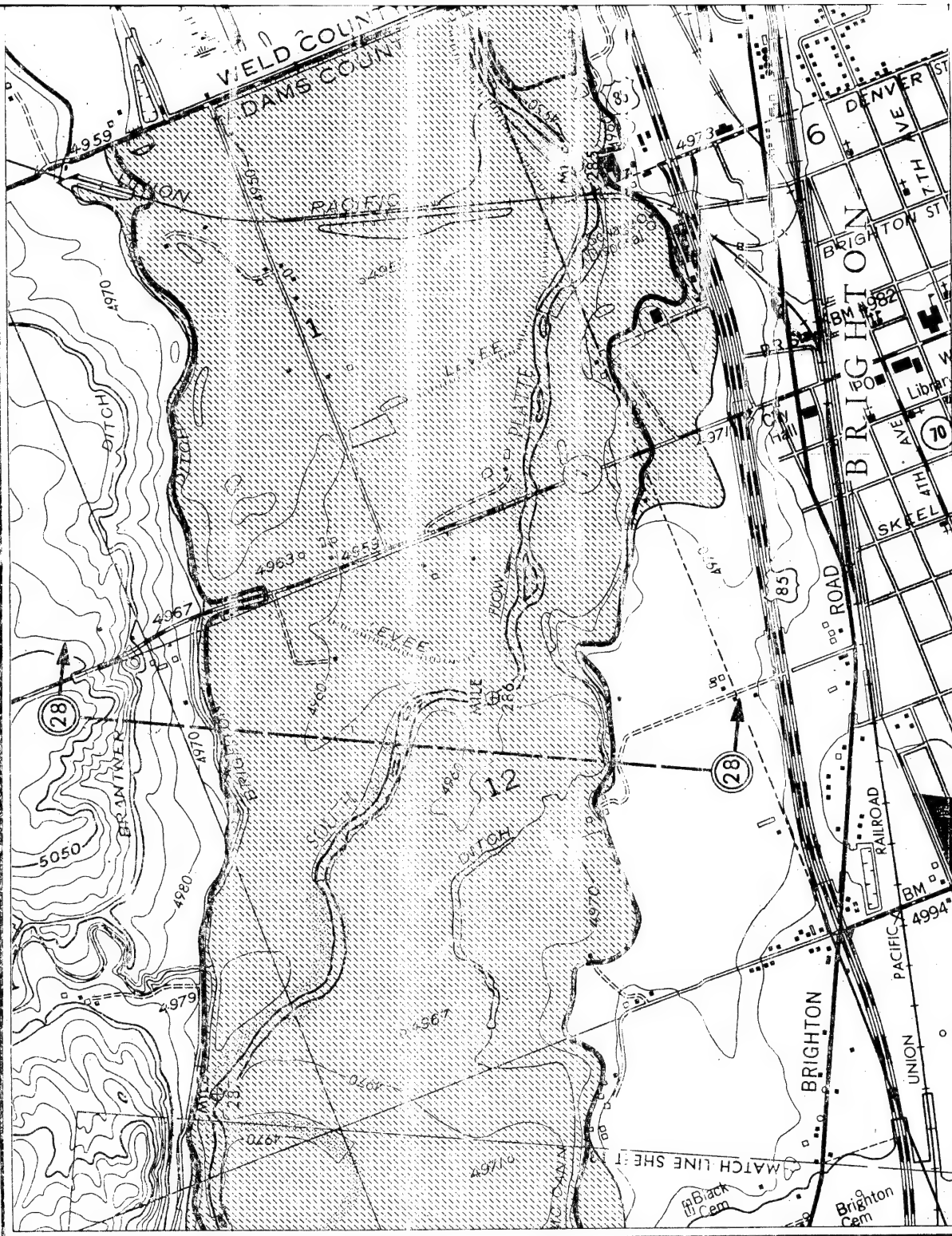
1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

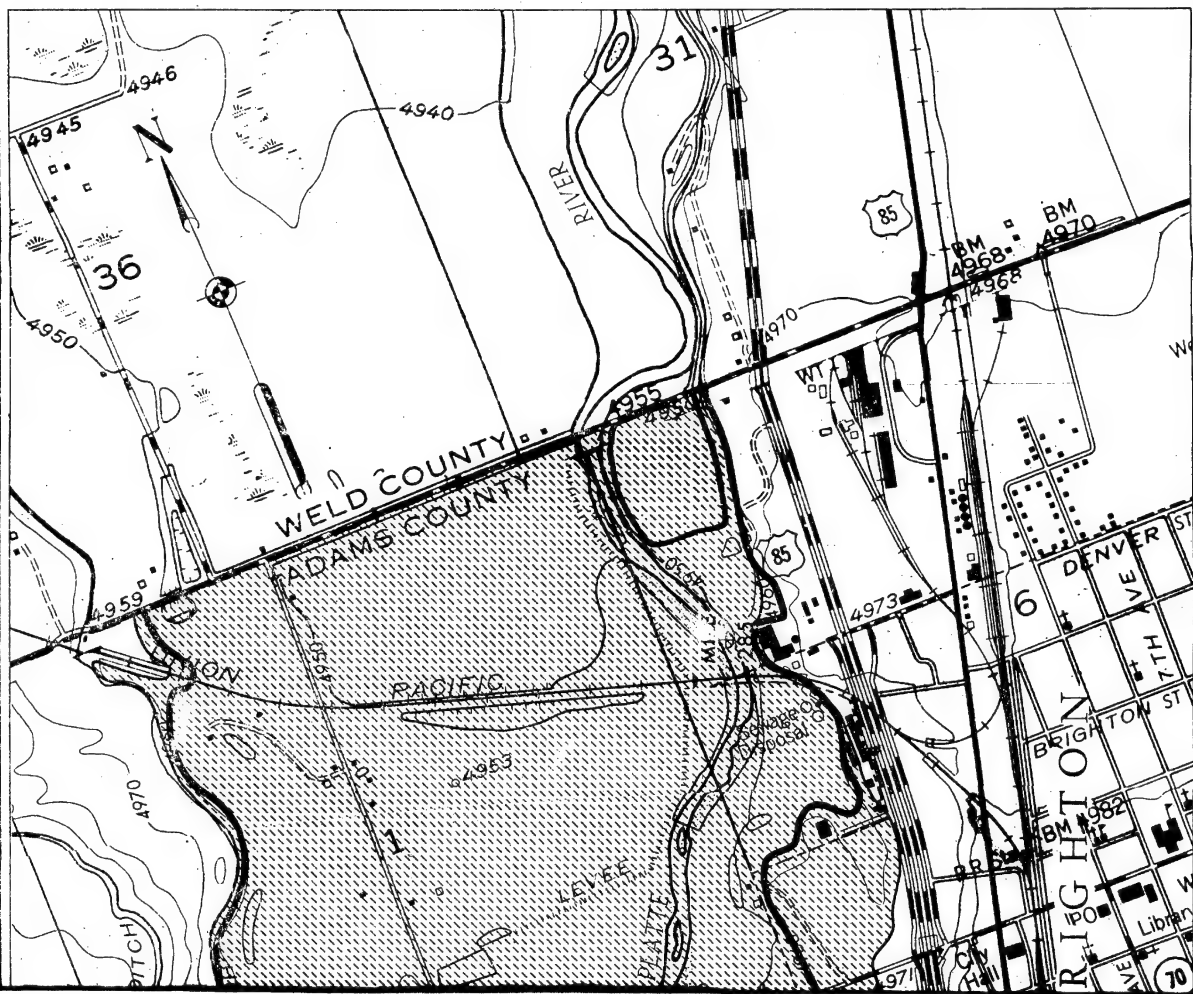
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 13 OF 14





LEGEND



Area of Indicated Flood Hazard



1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 9)

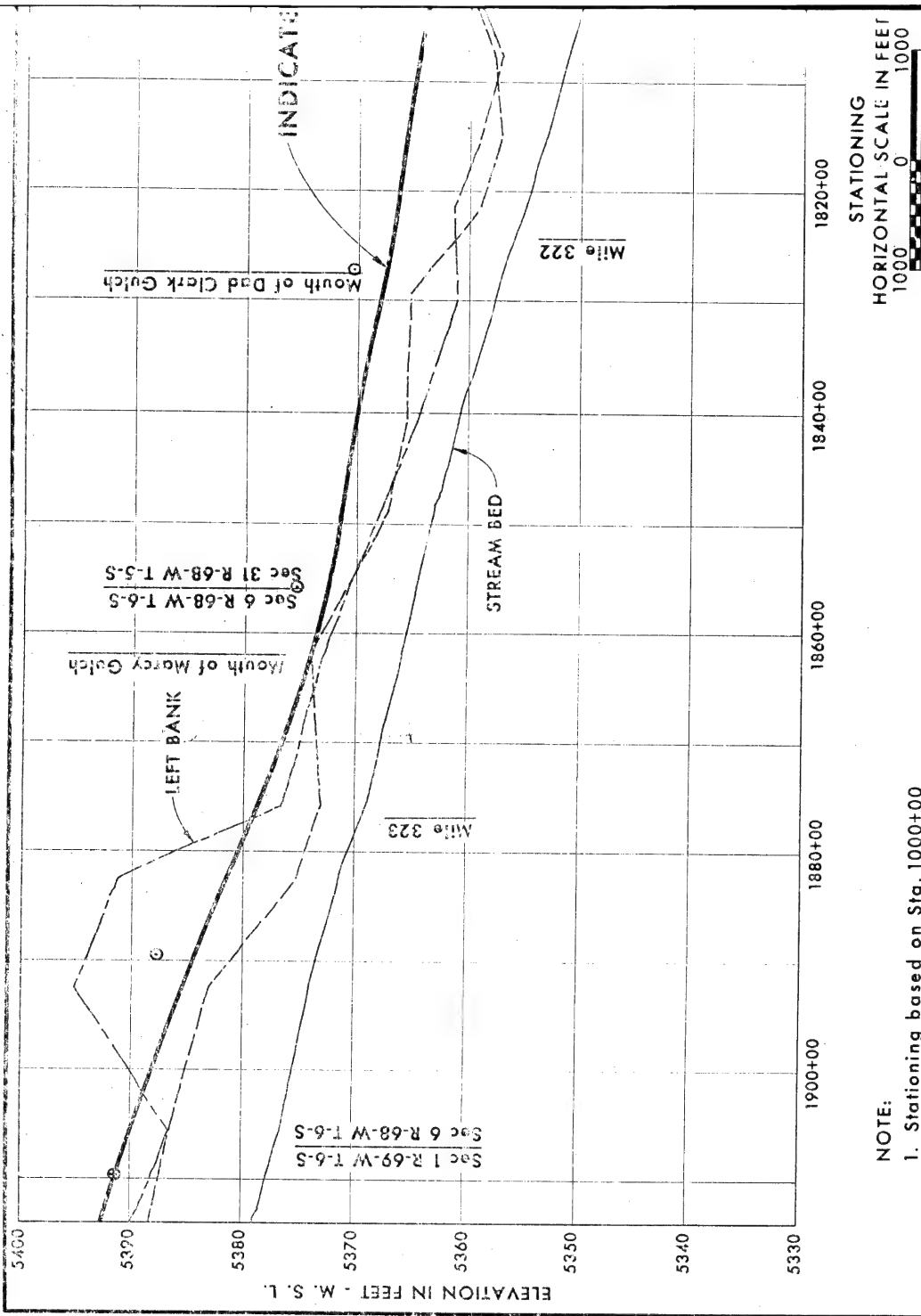
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SOUTH PLATTE RIVER,
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 14 OF 14

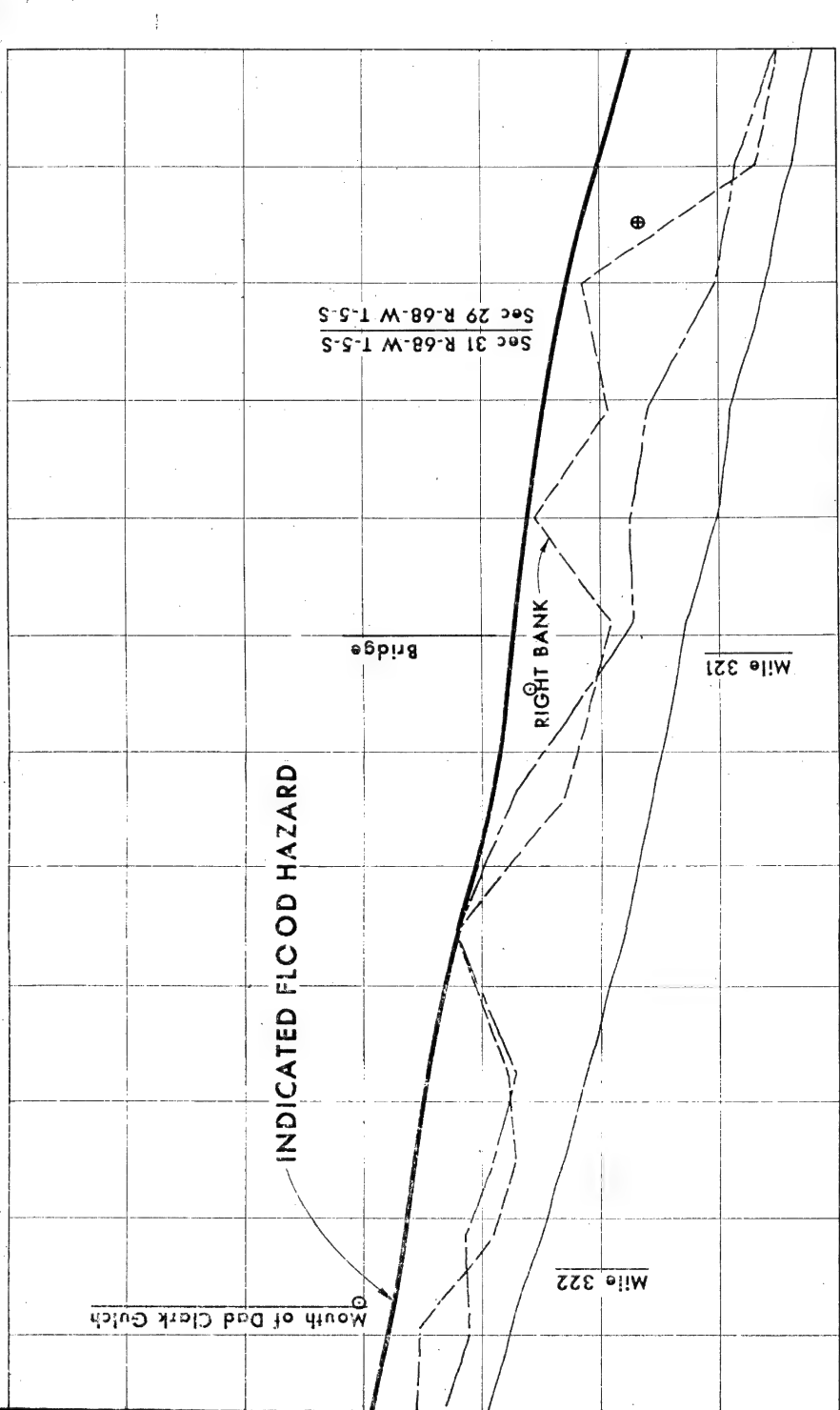
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NOTE:
1. Stationing based on Sta. 1000+00
at Denver gaging station.

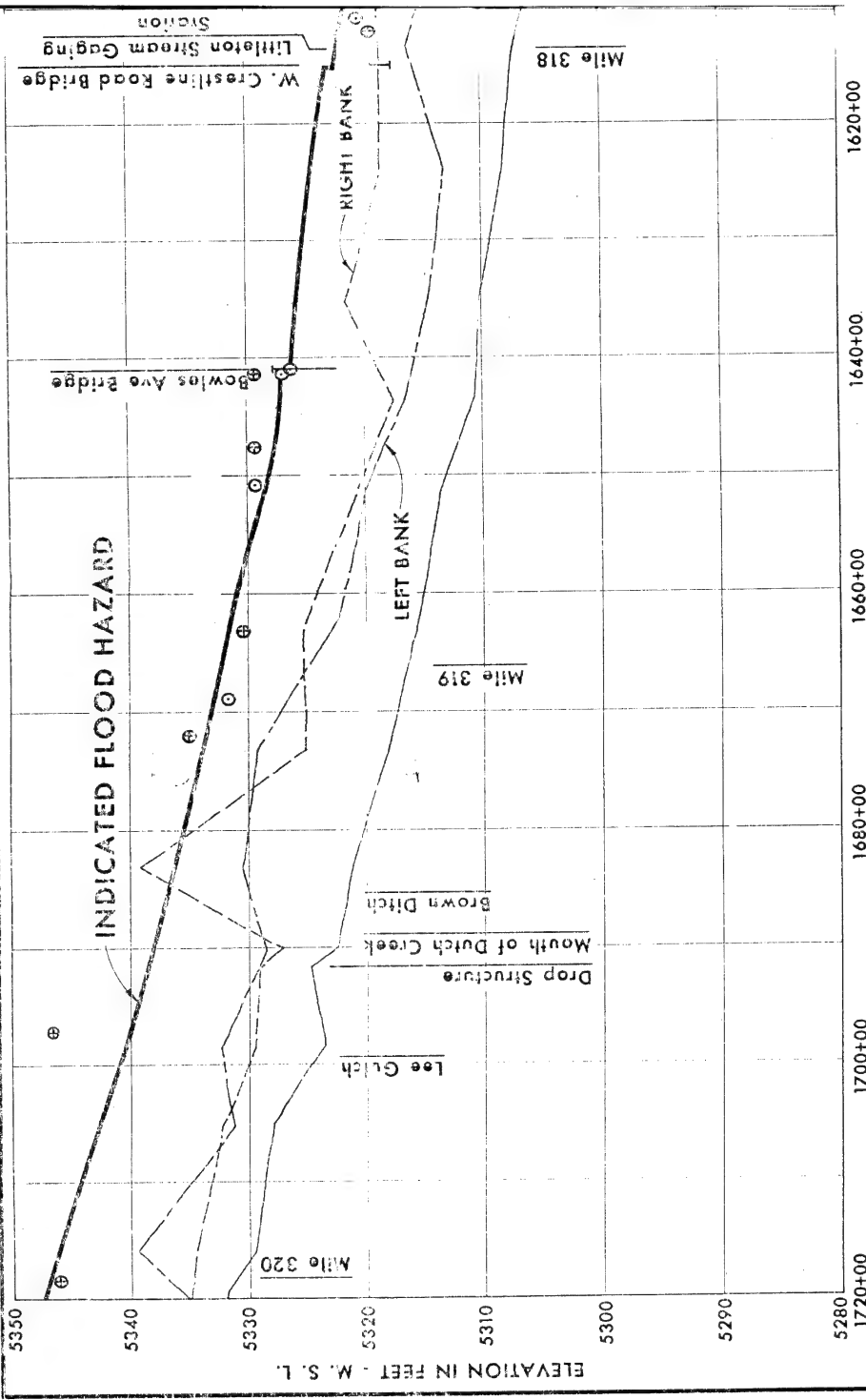
LEGEND

- June 1965 High Water Mark—Right Bank
- ⊕ June 1965 High Water Mark—Left Bank



1820+00 1800+00 1780+00 1760+00 1740+00 1720+00

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA



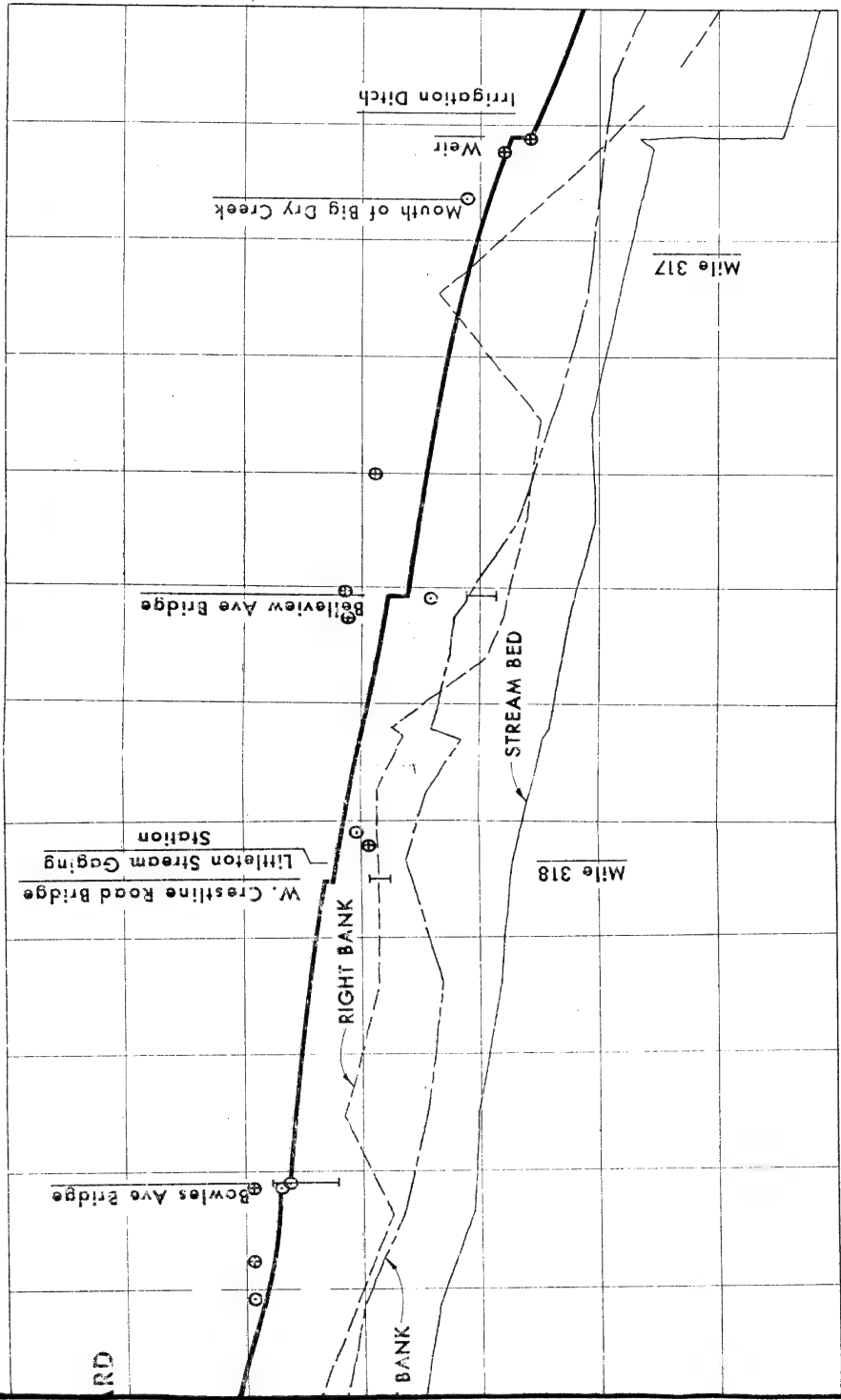
STATIONING
HORIZONTAL SCALE IN FEET
1000 0 1000

NOTE:
1. Stationing based on Sta. 1000+00
at Denver gaging station.

LEGEND

BRIDGE SYMBOL
— Deck Elevation
- - - Low Steel Elevation

○ June 1965 High Water Mark—Right Bank
⊕ June 1965 High Water Mark—Left Bank



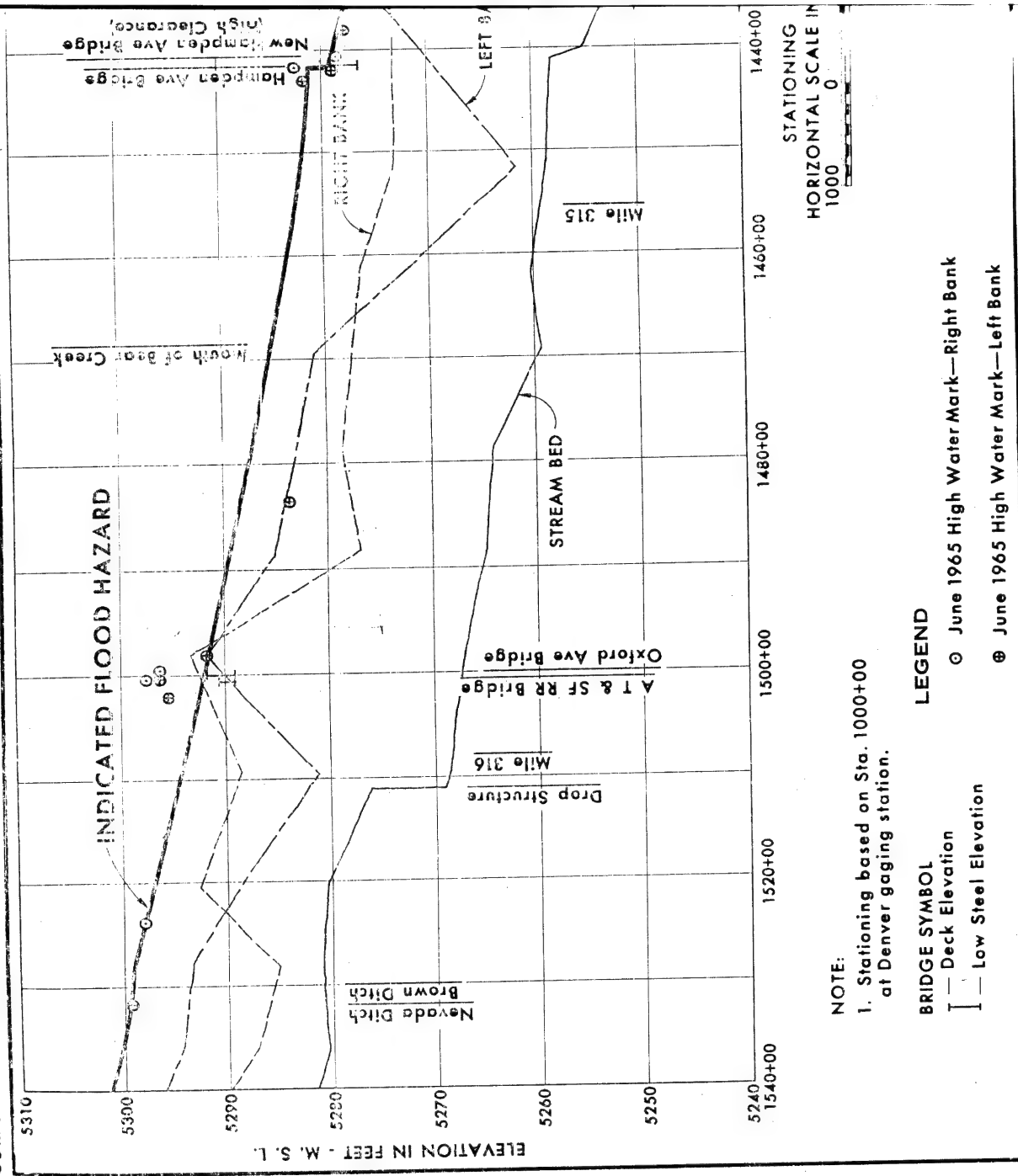
1640+00 1620+00 1600+00 1580+00 1560+00 1540+00

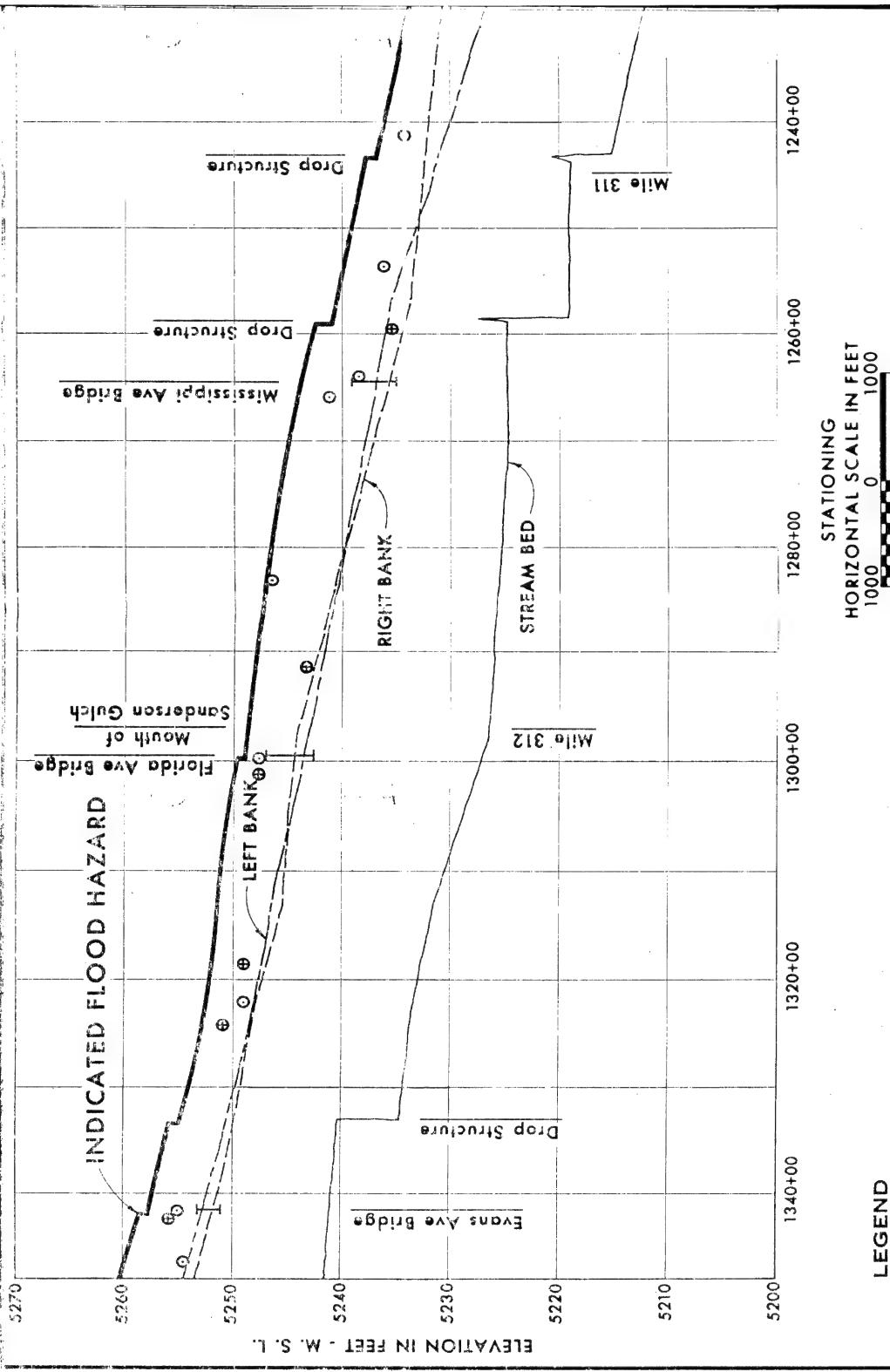
STATIONING
HORIZONTAL SCALE IN FEET
1000 0 1000

SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

er Mark—Right Bank
er Mark—Left Bank

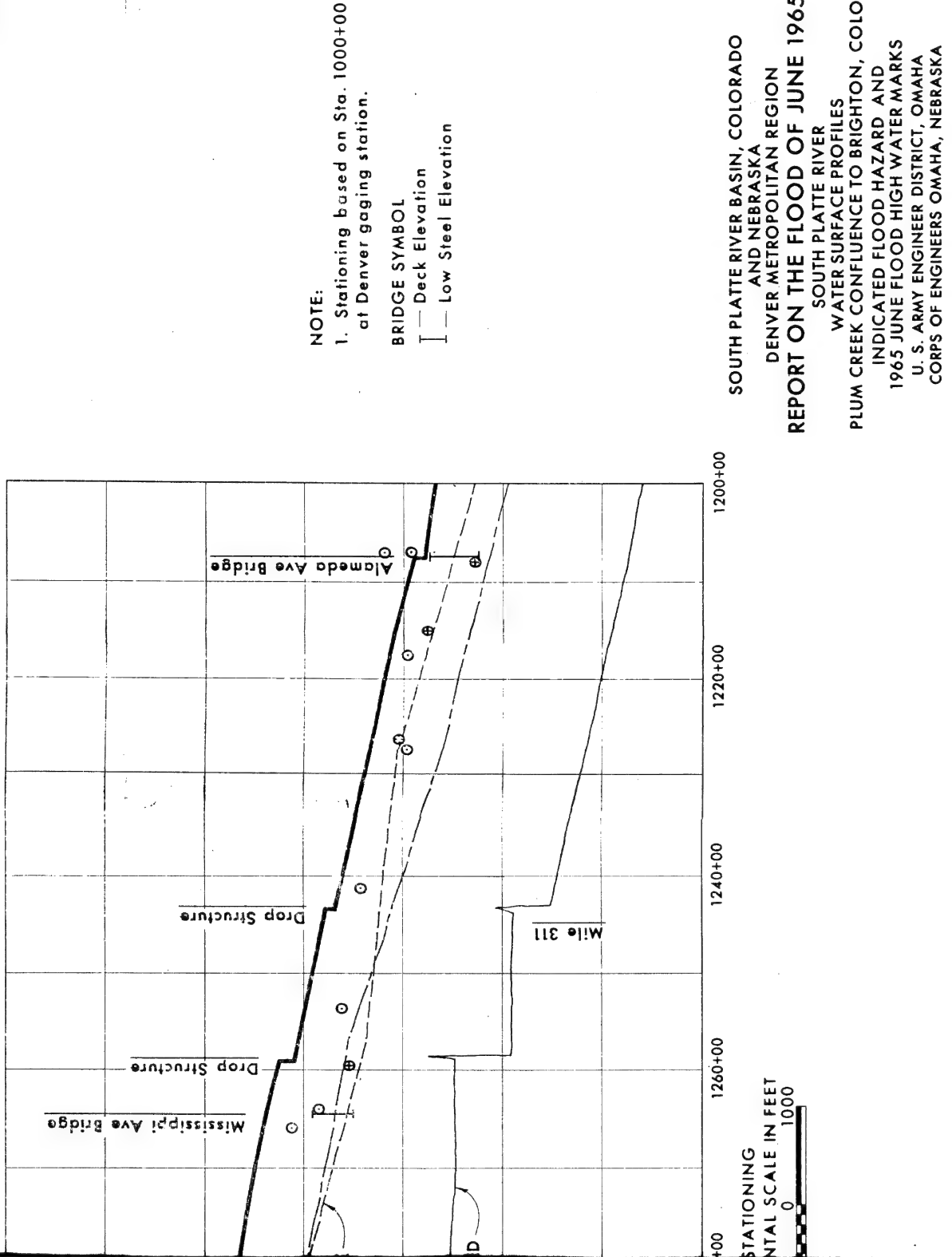
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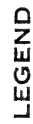


LEGEND

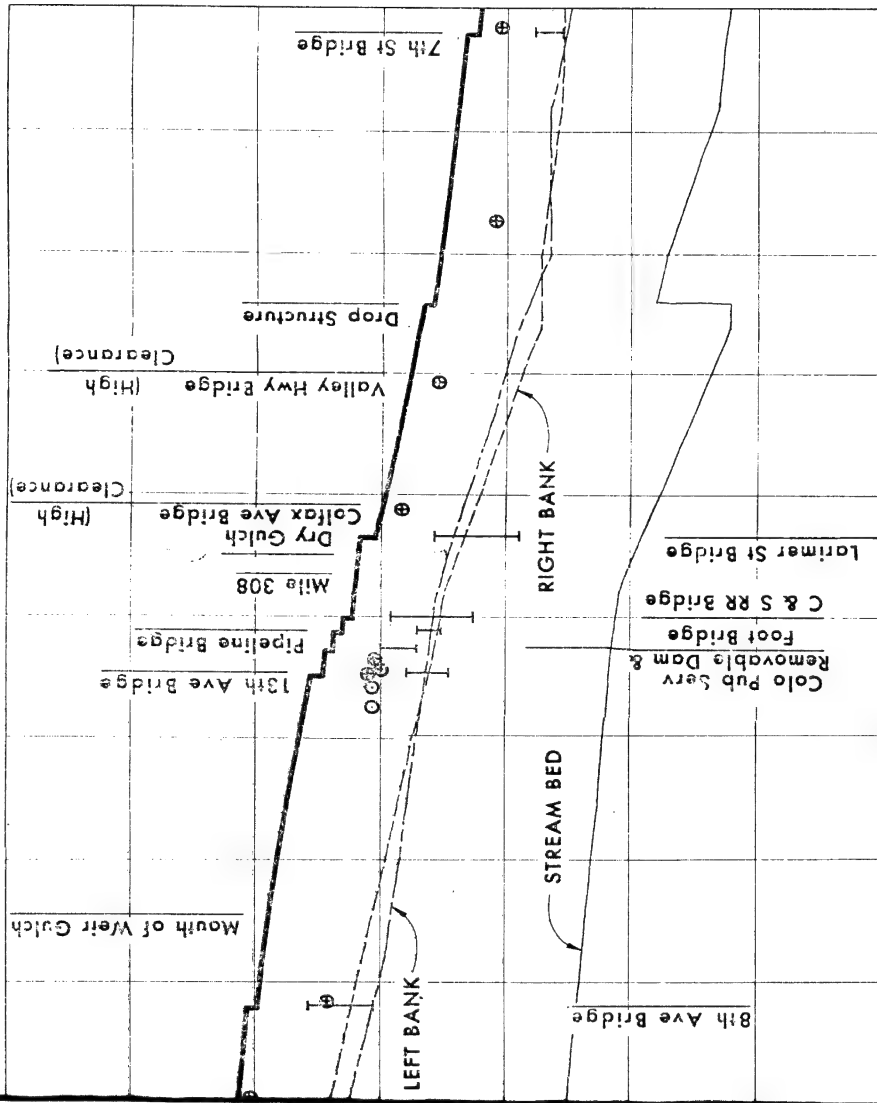
- June 1965 High Water Mark—Right Bank
- ⊗ June 1965 High Water Mark—Left Bank



SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA



- © June 1965 High Water Mark—Right Bank
⊕ June 1965 High Water Mark—Left Bank



NOTE:

1. Stationing based on Sta. 1000+00 at Denver gaging station.

BRIDGE SYMBOL

— Deck Elevation
I — Low Steel Elevation

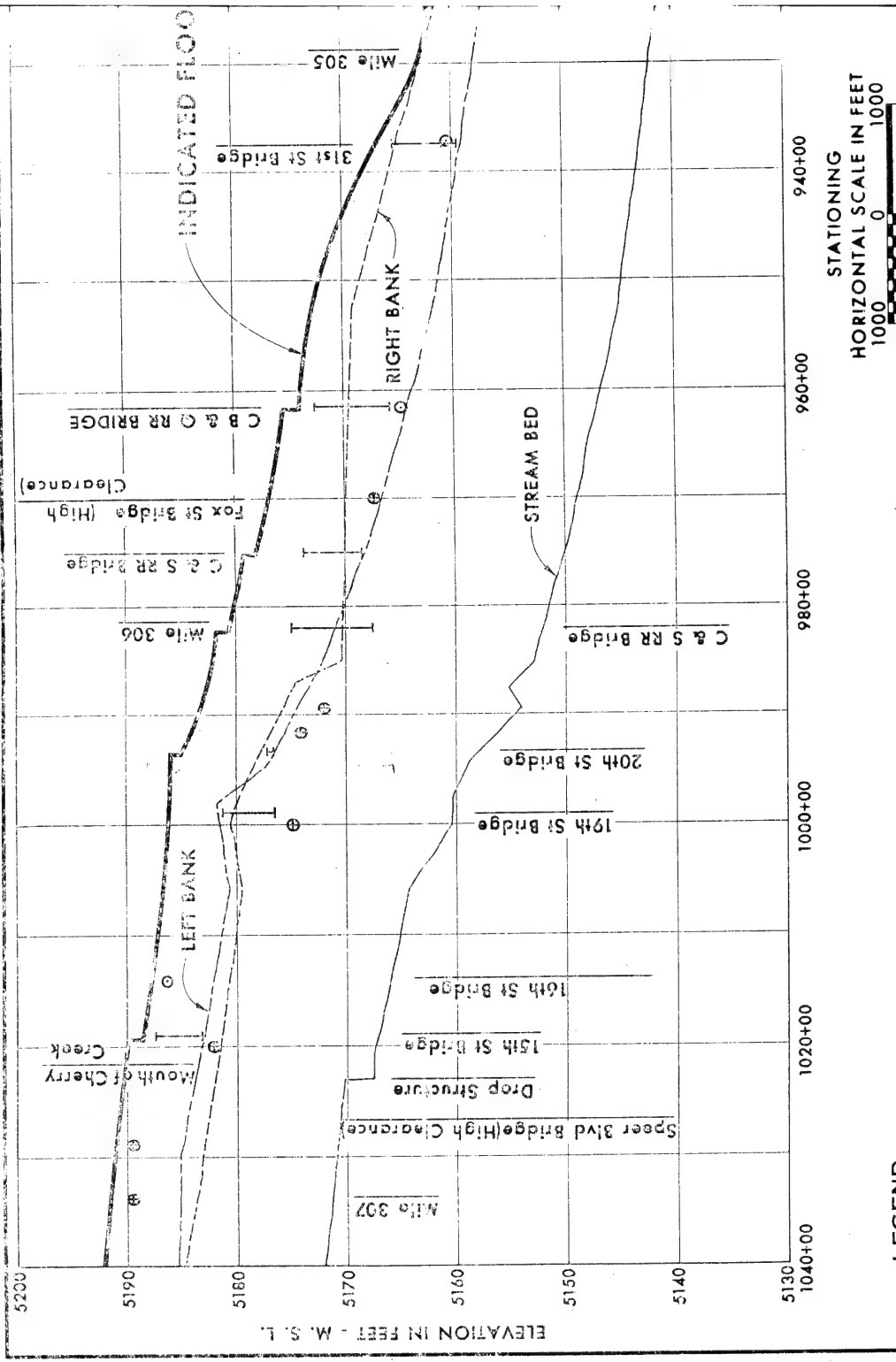
STATIONING
HORIZONTAL SCALE IN FEET
00 0 1000

1040+00
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965

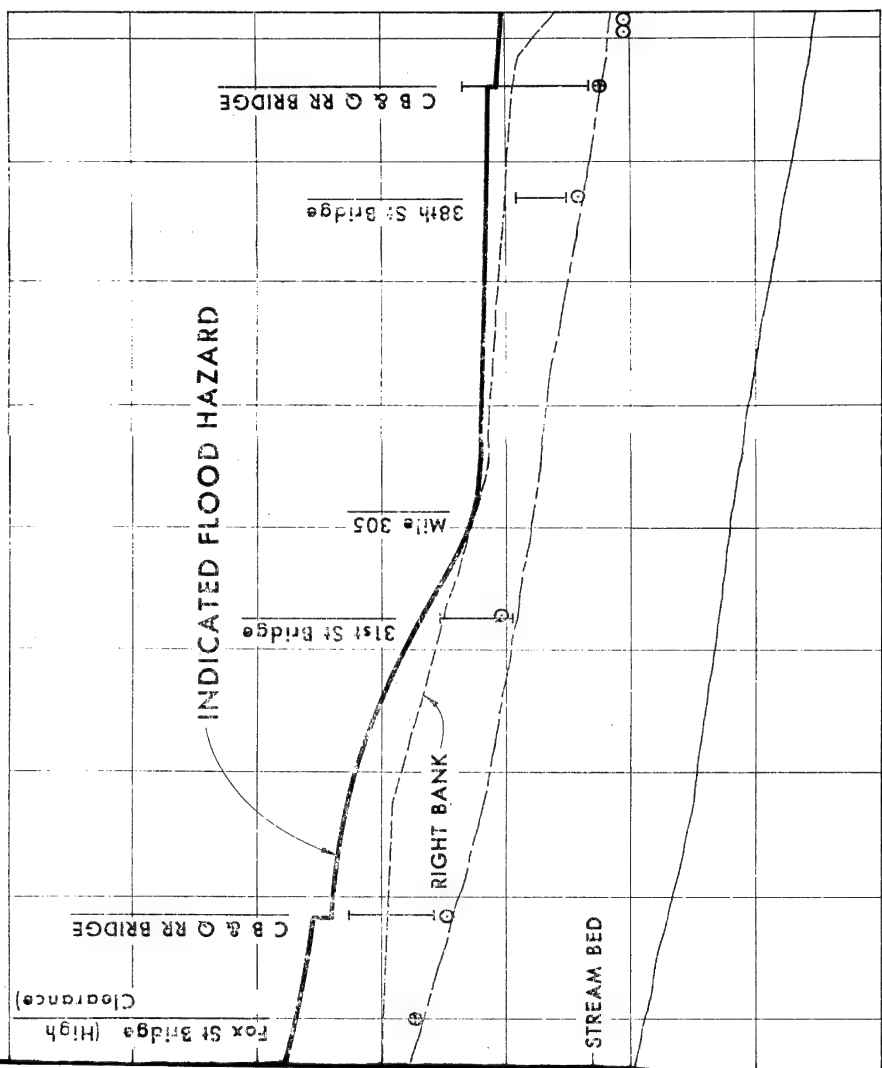
SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

2



LEGEND

- June 1965 High Water Mark—Right Bank
- ⊗ June 1965 High Water Mark—Left Bank



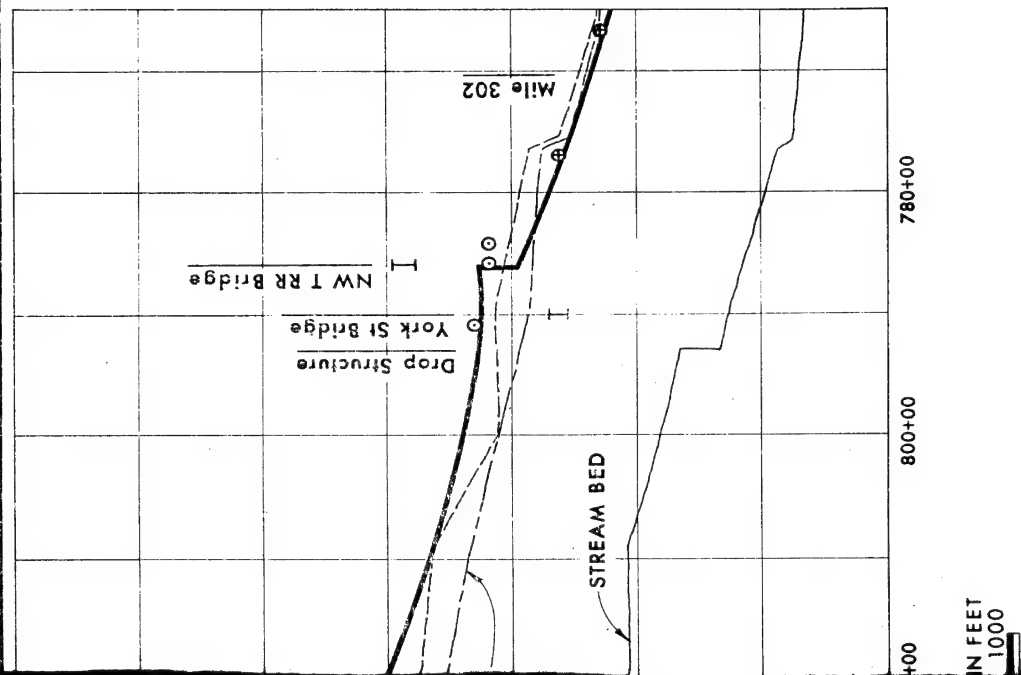
NOTE:
1. Stationing based on Sta. 1000+00 at Denver gaging station.

BRIDGE SYMBOL
— Deck Elevation
— Low Steel Elevation

SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

⊙ June 1965 High Water Mark—Right Bank
⊕ June 1965 High Water Mark—Left Bank

①



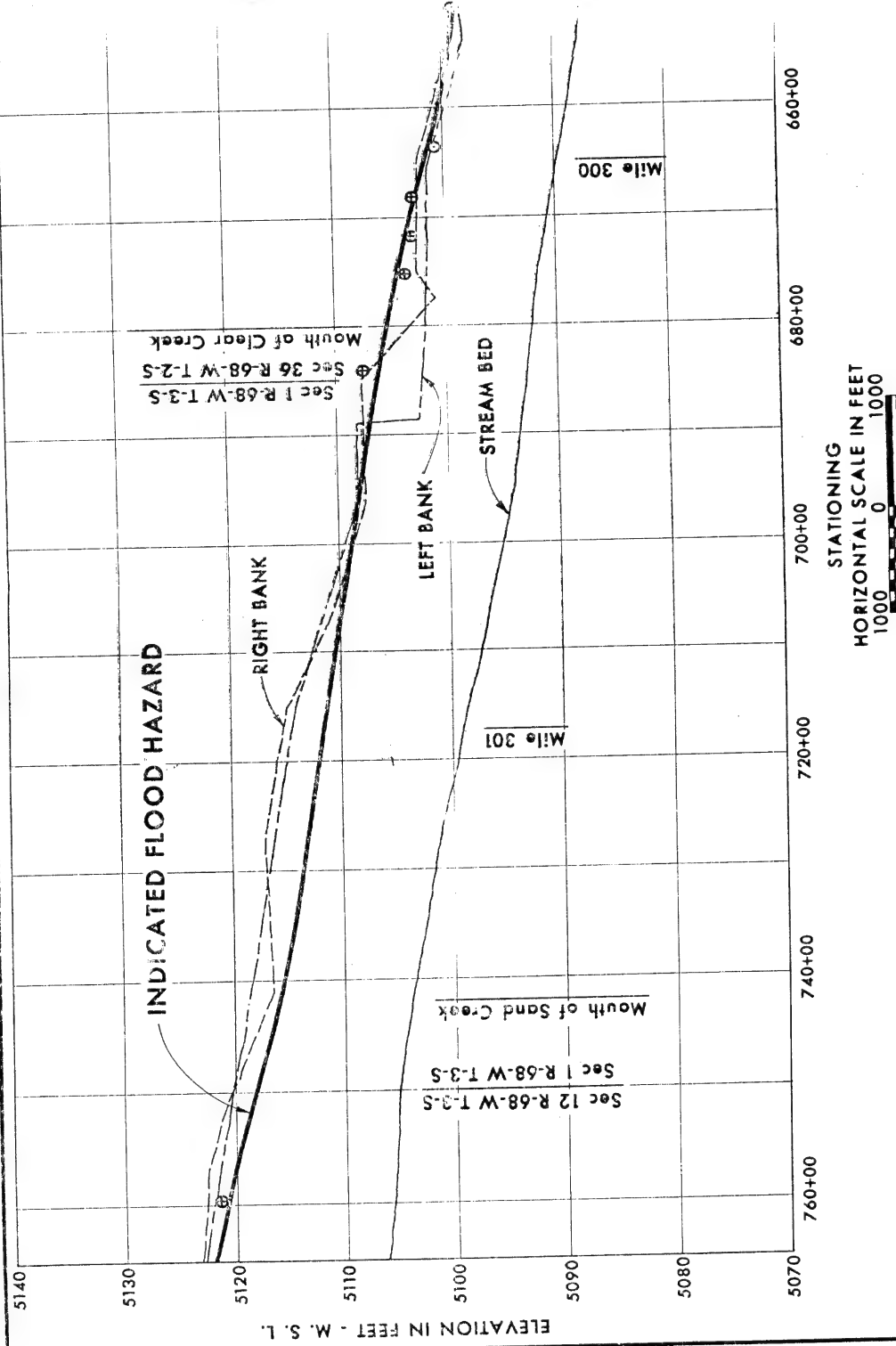
NOTE:
1. Stationing based on Sta. 1000+00
at Denver gaging station.

BRIDGE SYMBOL
— Deck Elevation
I — Low Steel Elevation

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

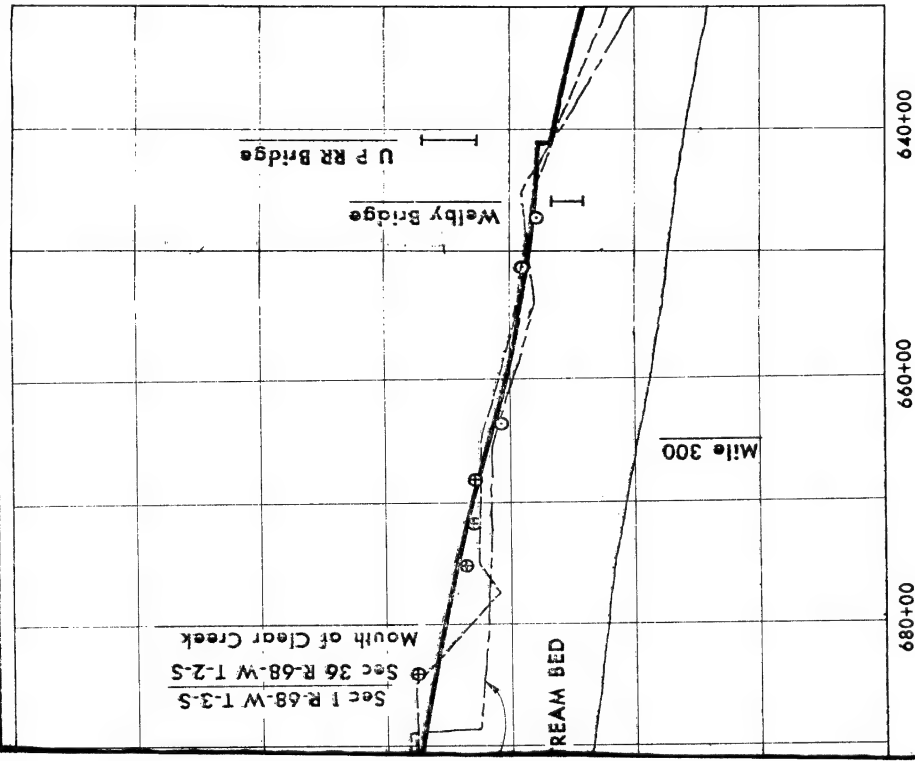
REPORT ON THE FLOOD OF JUNE 1965

SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD
AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA



LEGEND

- ⊙ June 1965 High Water Mark—Right Bank
- ⊗ June 1965 High Water Mark—Left Bank

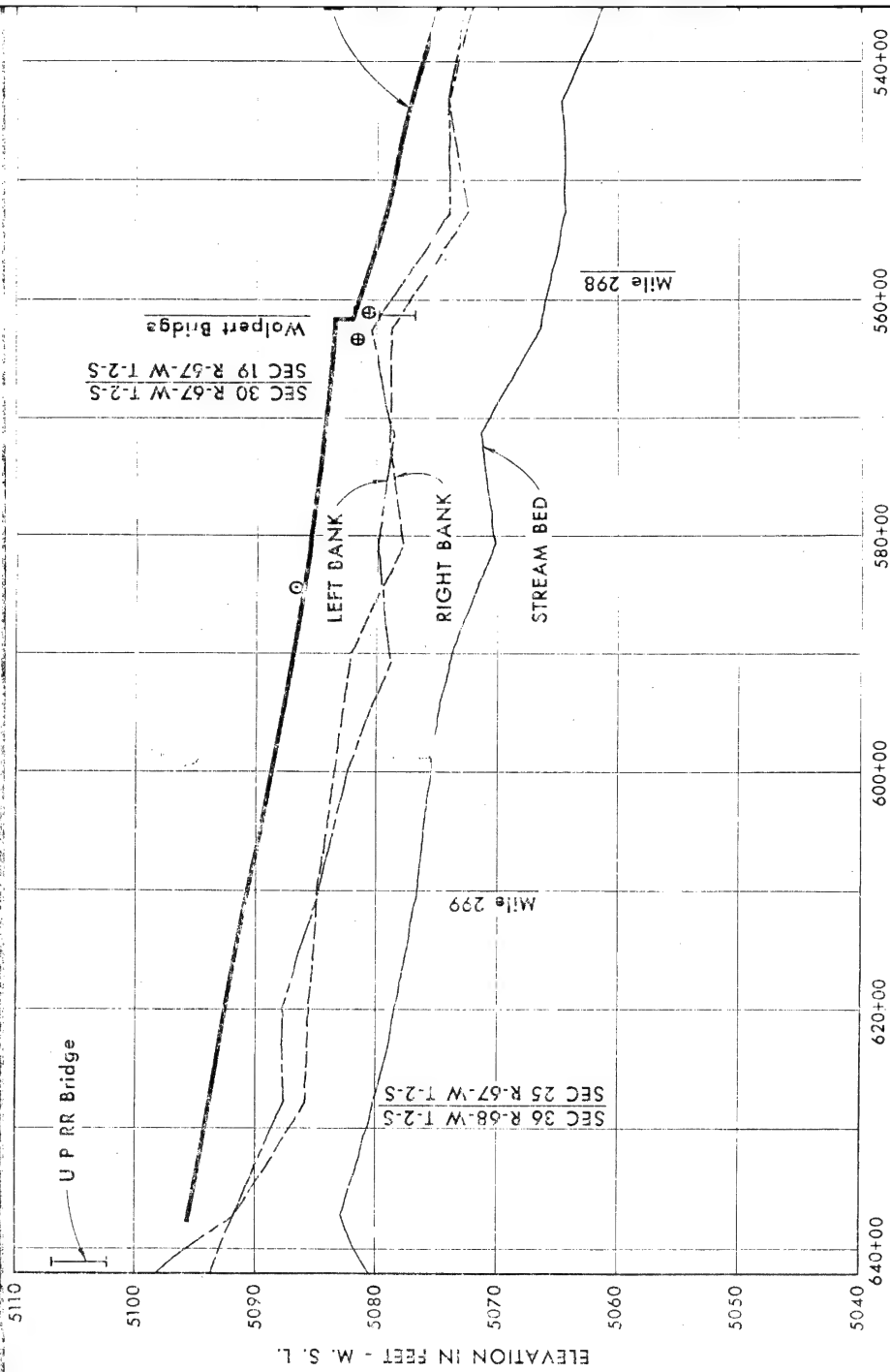


NOTE:
1. Stationing based on Sta. 1000+00
at Denver gaging station.

BRIDGE SYMBOL
— Deck Elevation
- - Low Steel Elevation

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD
AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

2



NOTE:

1. Stationing based on Sta. 1000+00 at Denver gaging station.

LEGEND

BRIDGE SYMBOL

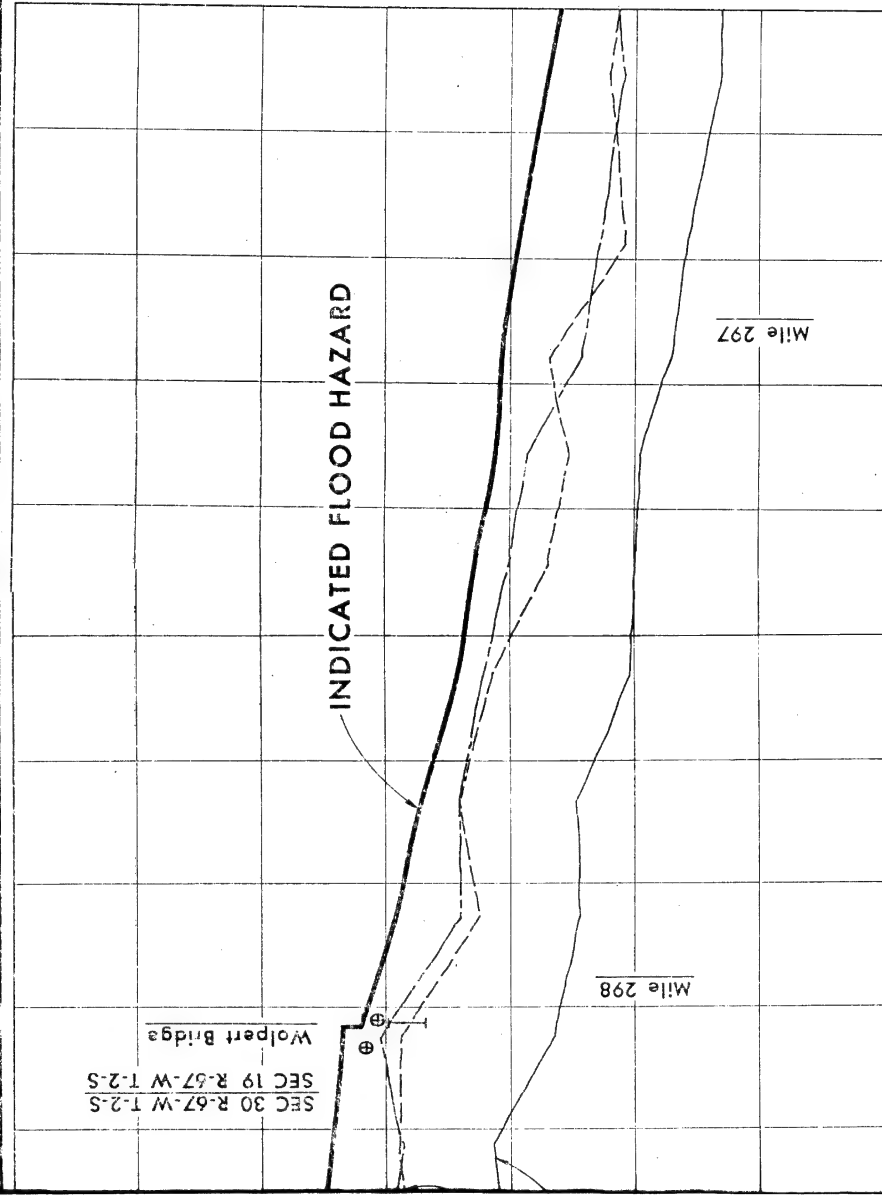
I — Deck Elevation

— Low Steel Elevation

O June 1965 High Water Mark—Right Bank

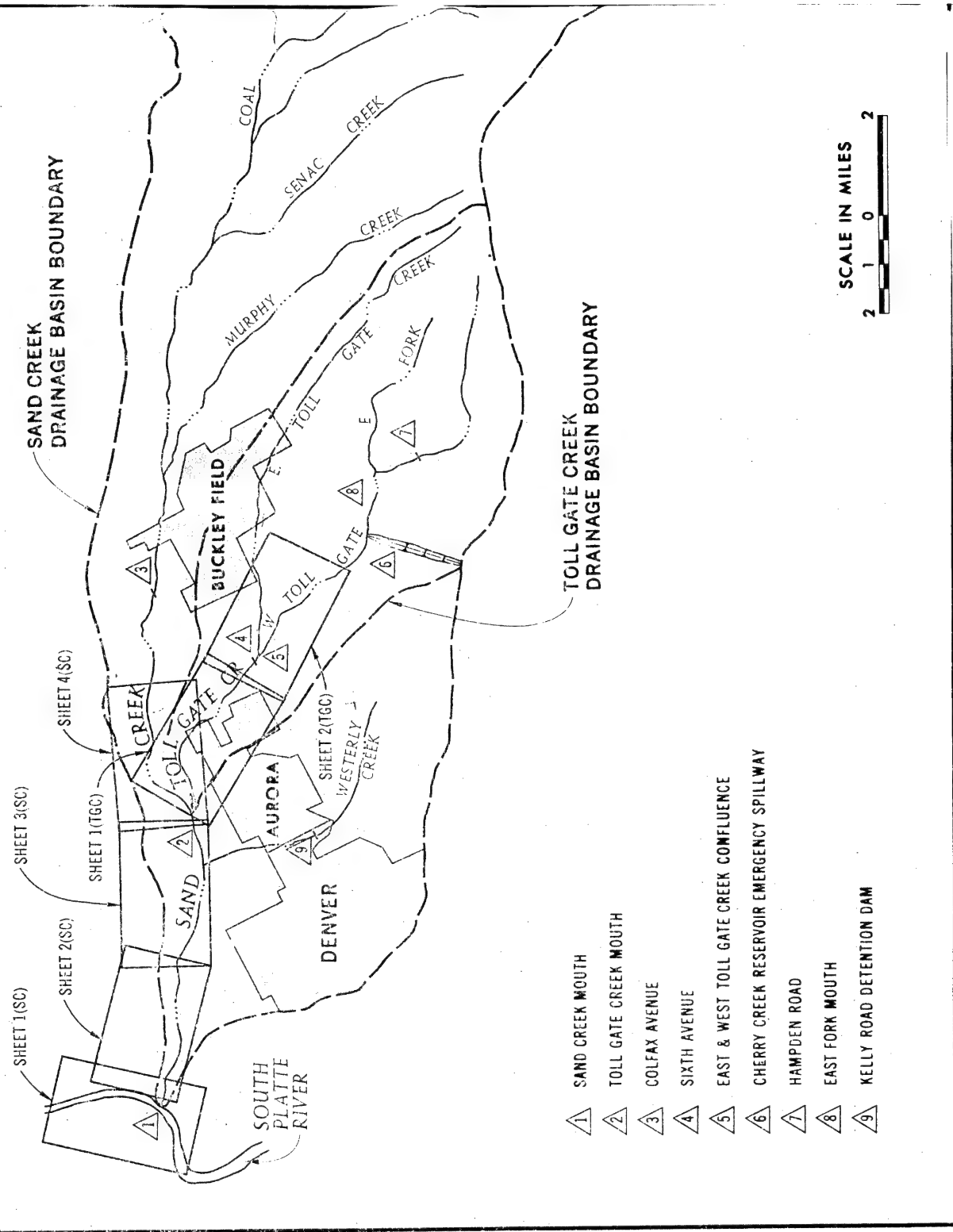
⊕ June 1965 High Water Mark—Left Bank

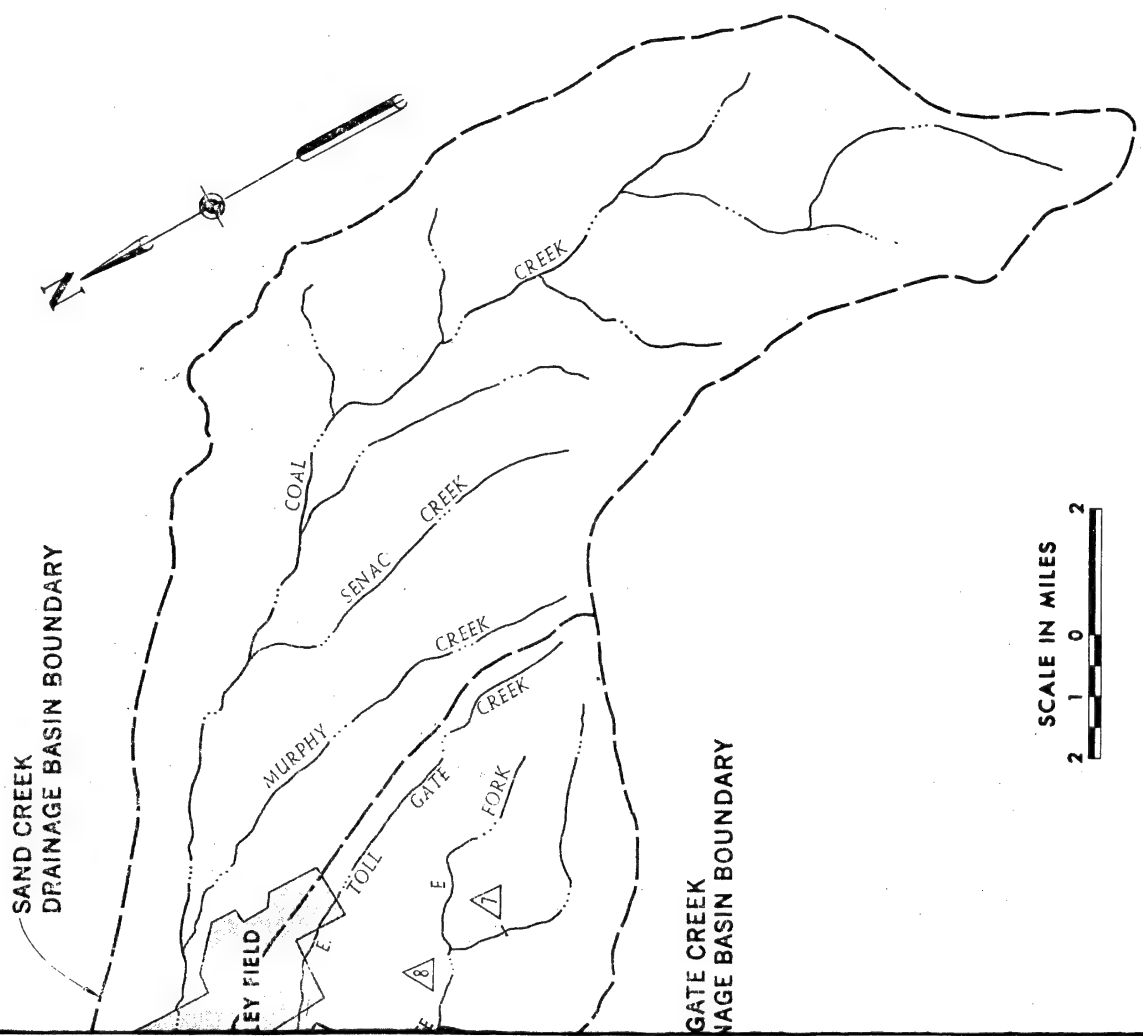
①



480+00 500+00 520+00 540+00 560+00

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SOUTH PLATTE RIVER
WATER SURFACE PROFILES
PLUM CREEK CONFLUENCE TO BRIGHTON, COLO.
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA





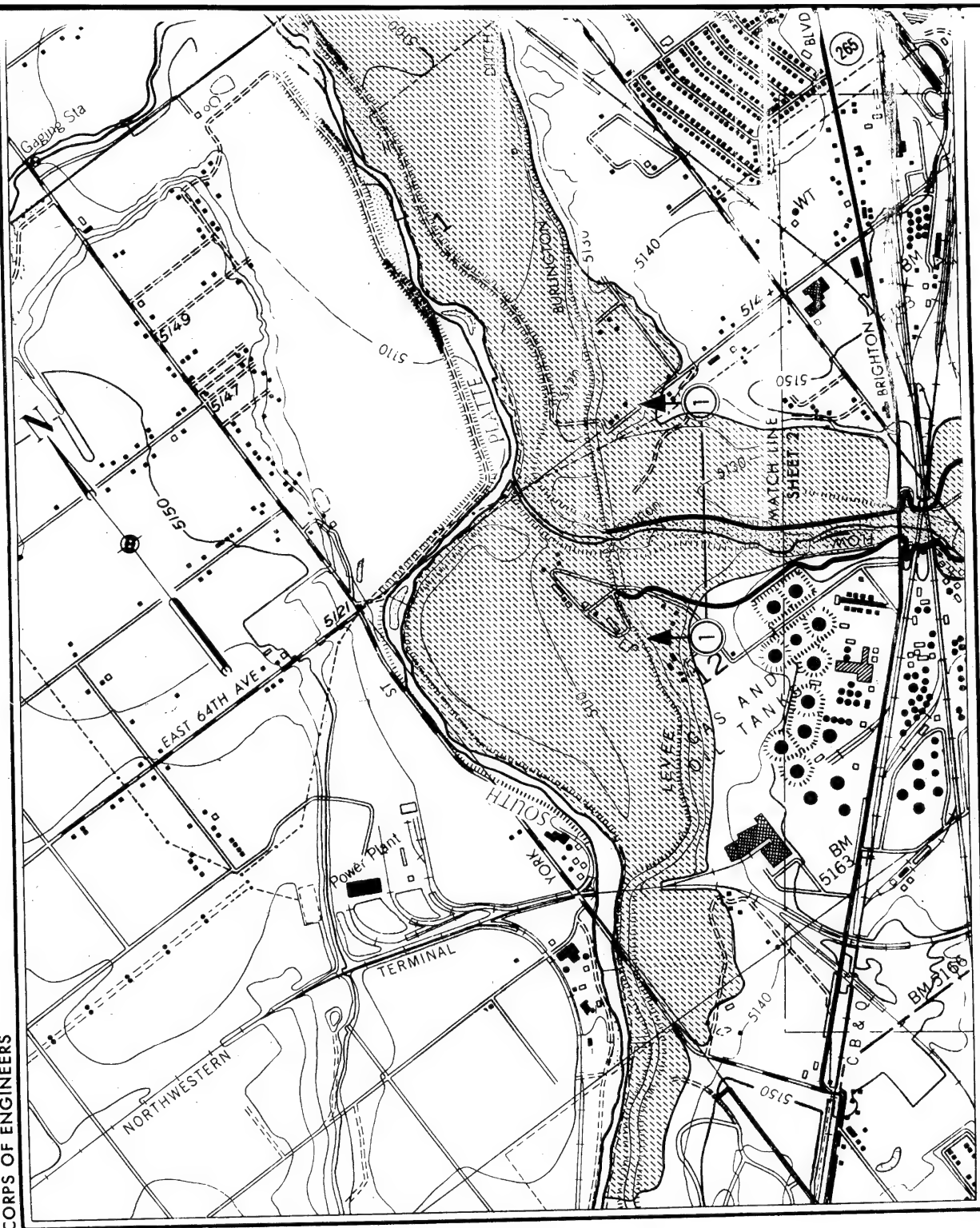
INDEX TO FLOOD OUTLINE EXHIBITS

INDEX SHEET	MAP EXHIBIT
1(SC)	PLATE 34
2(SC)	35
3(SC)	36
4(SC)	37
1(TGC)	38
2(TGC)	39

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965

BASIN AND INDEX MAP
SAND AND TOLL GATE CREEKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967



Topography reproduced from 1957 U.S.G.S. quadrangle, Denver and vicinity, Colo.



NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 33)

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF SAND CREEK,
CHAMBERS ROAD TO MOUTH

SCALE IN FEET
1000 0 1000 2000

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967
SHEET 1 OF 4

CONTOUR INTERVAL 10 FEET

2

LEGEND

Area of Indicated Flood Hazard

1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 33)

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965

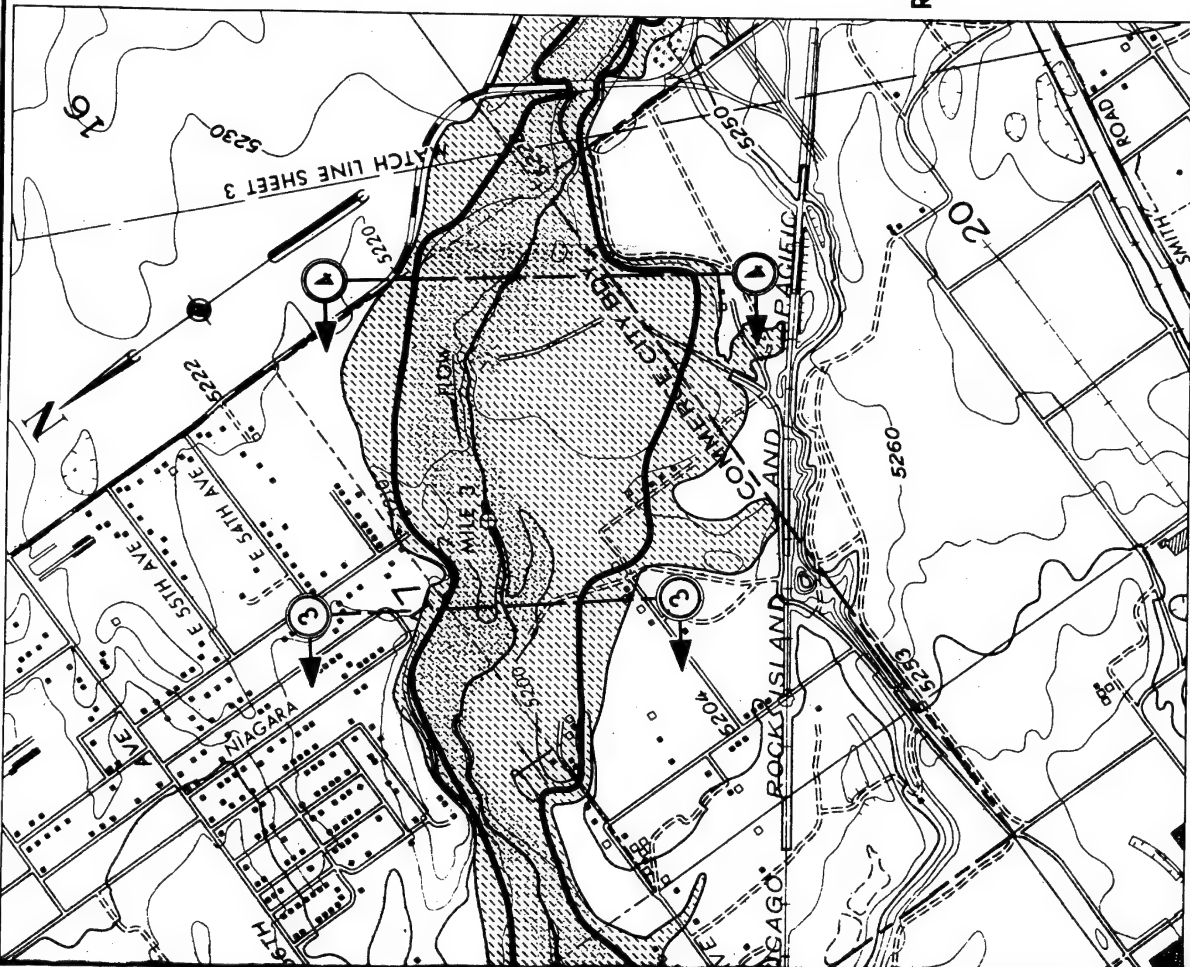
FLOOD OUTLINE OF SAND CREEK,
CHAMBERS ROAD TO MOUTH

SCALE IN FEET
1000 0 1000 2000

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 2 OF 4

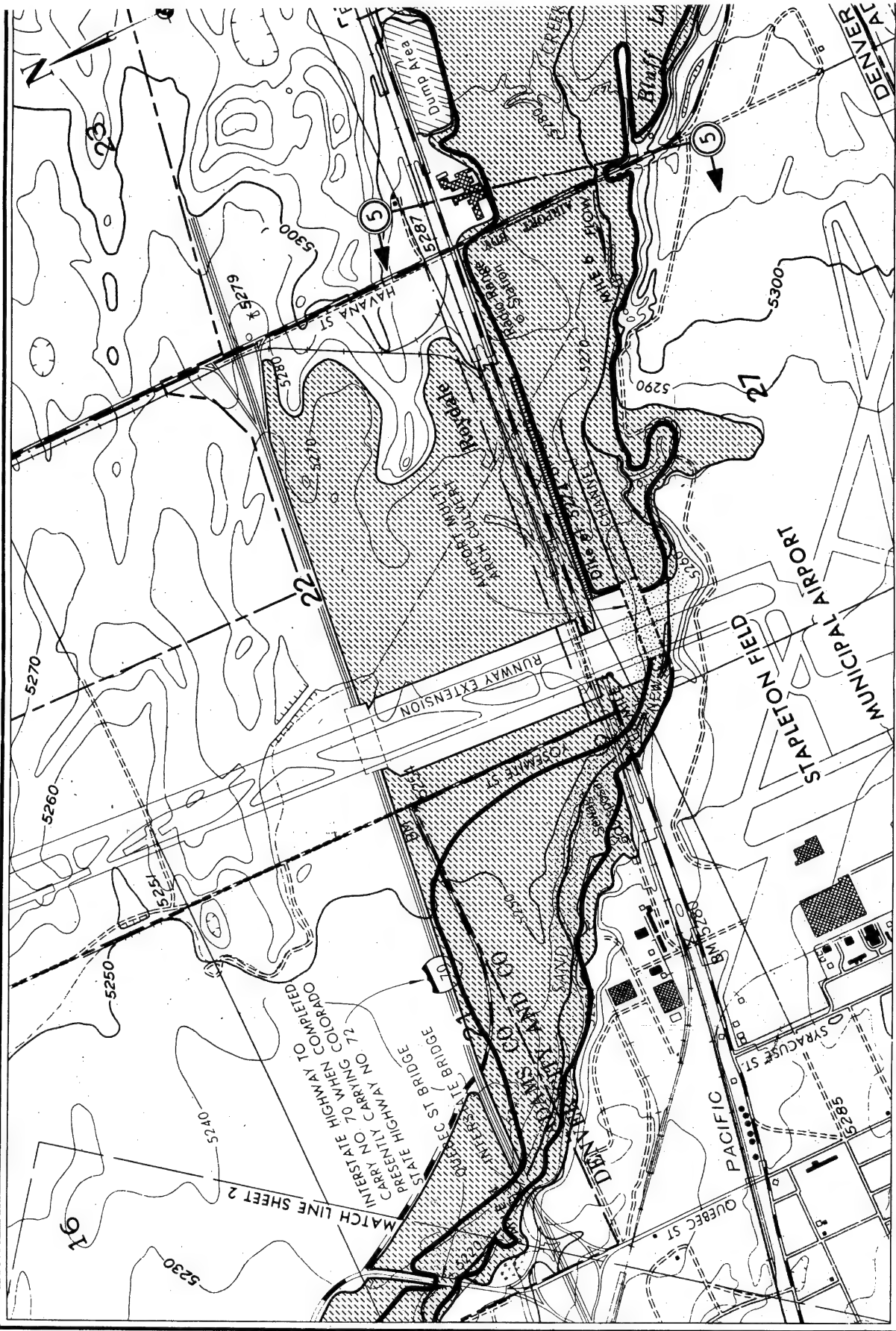
CONTOUR INTERVAL 10 FEET

2



CONTOUR INTERVAL 10 FEET

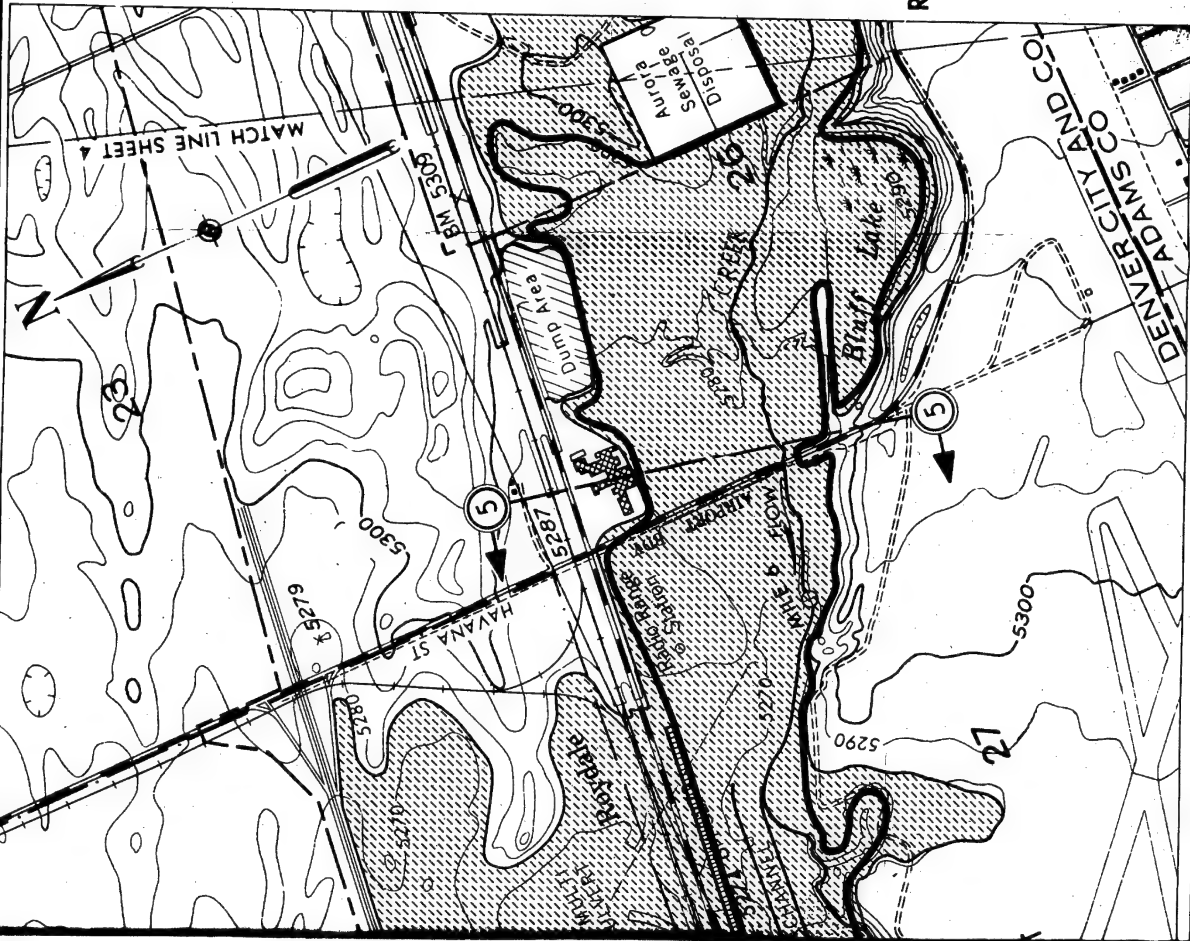
2



Topography reproduced from 1957 U. S. G. S. quadrangle, Denver and vicinity, Colo.

17

22



LEGEND

Area of Indicated Flood Hazard

1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 33)

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION

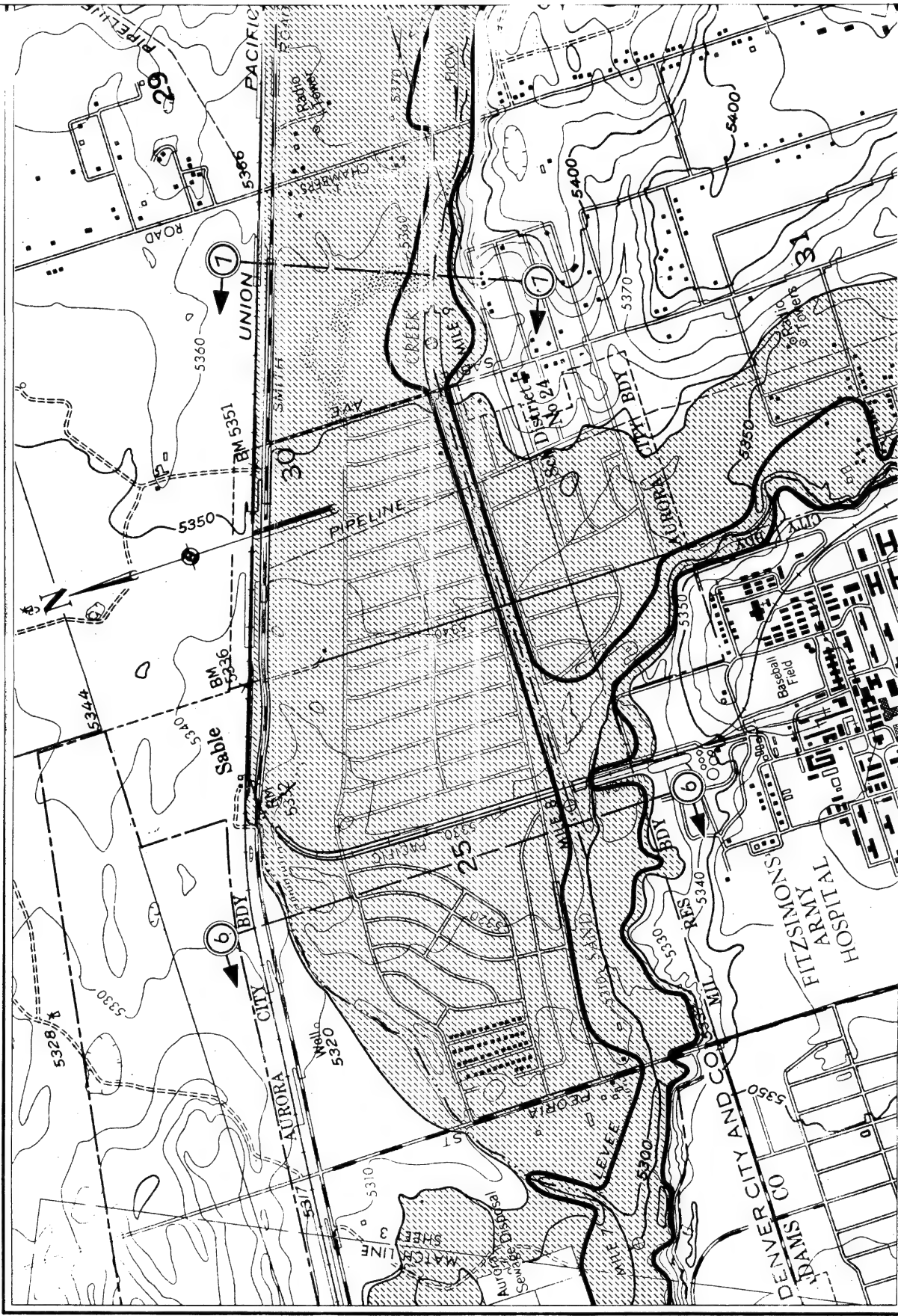
REPORT ON THE FLOOD OF JUNE 1965

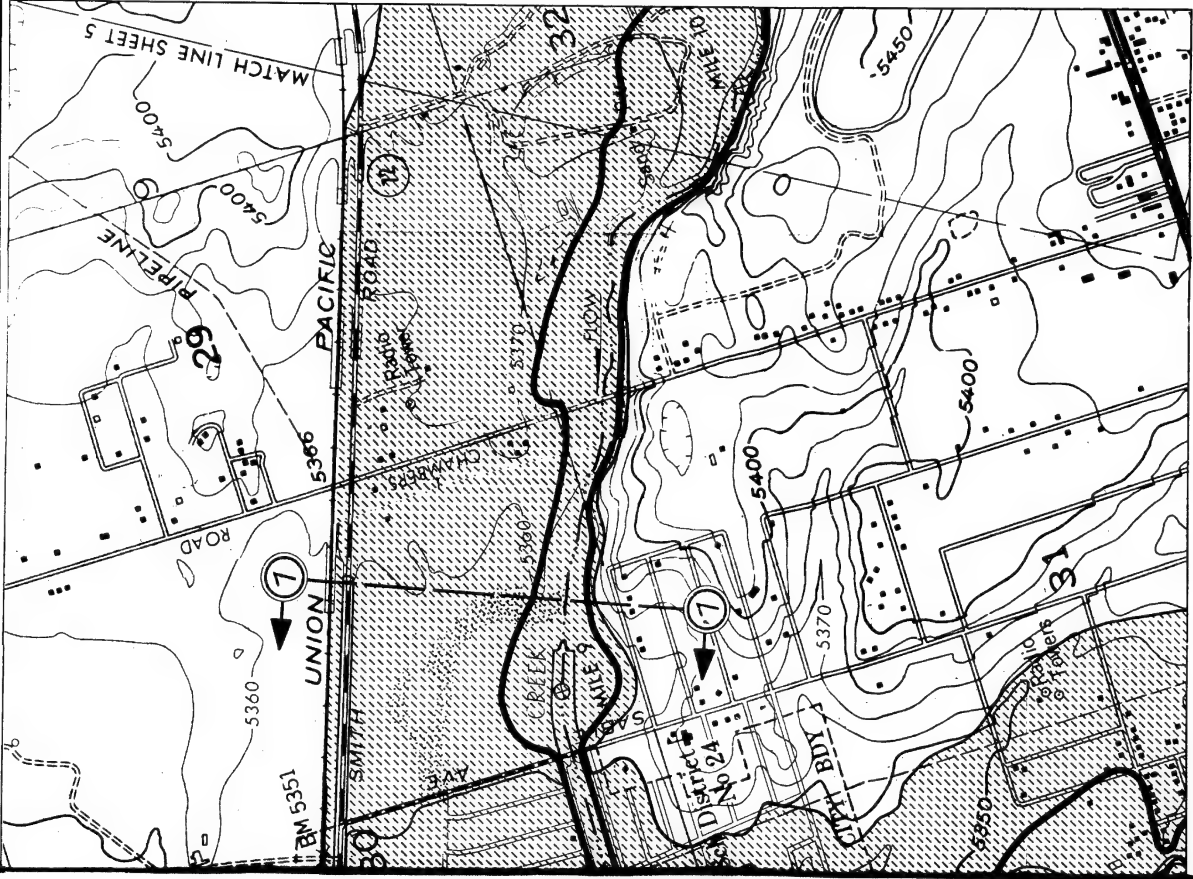
FLOOD OUTLINE OF SAND CREEK,
CHAMBERS ROAD TO MOUTH

SCALE IN FEET



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 3 OF 4





LEGEND

Area of Indicated Flood Hazard

1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 33)

SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965

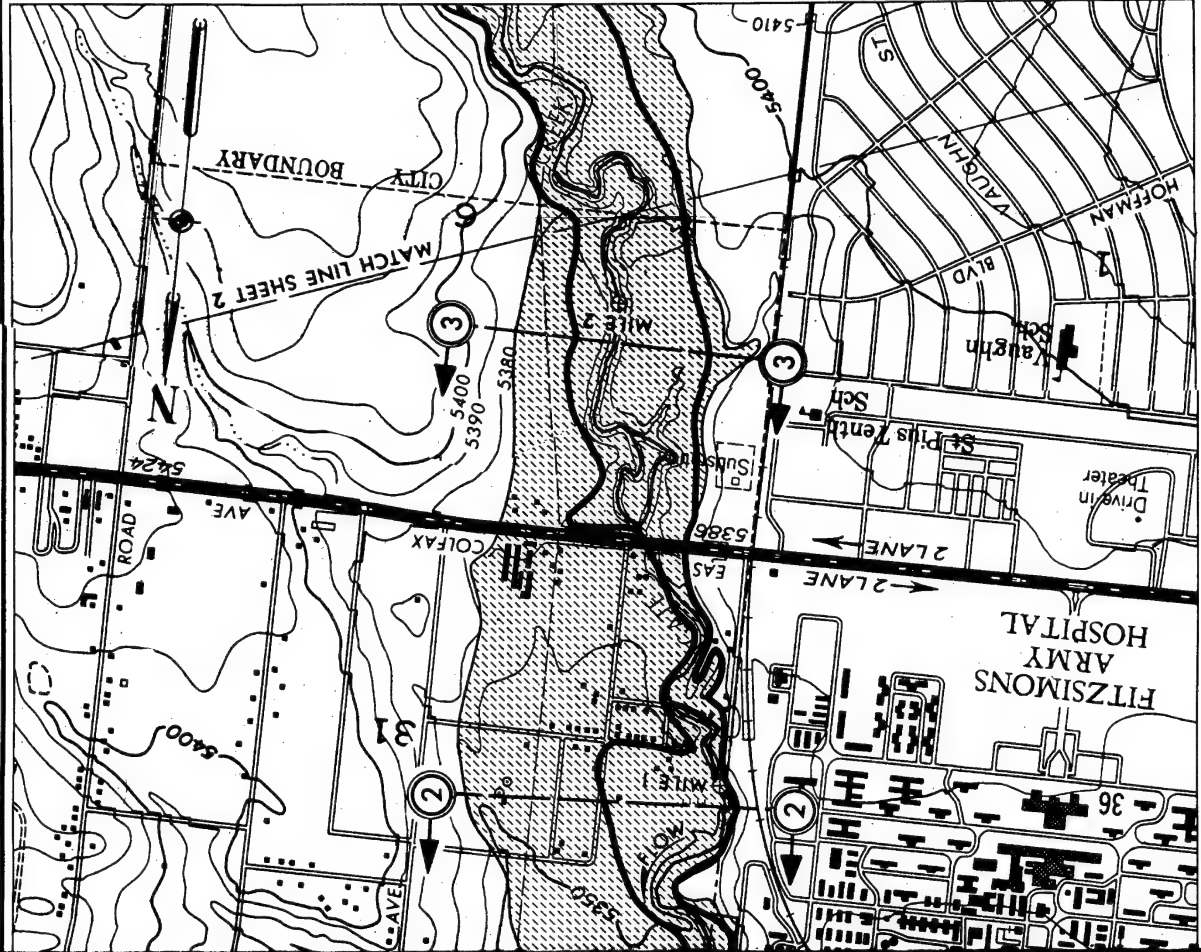
FLOOD OUTLINE OF SAND CREEK,
CHAMBERS ROAD TO MOUTH

SCALE IN FEET



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 4 OF 4

CONTOUR INTERVAL 10 FEET



LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

1. See study index map for the location of this sheet. (APPENDIX I PLATE 33)

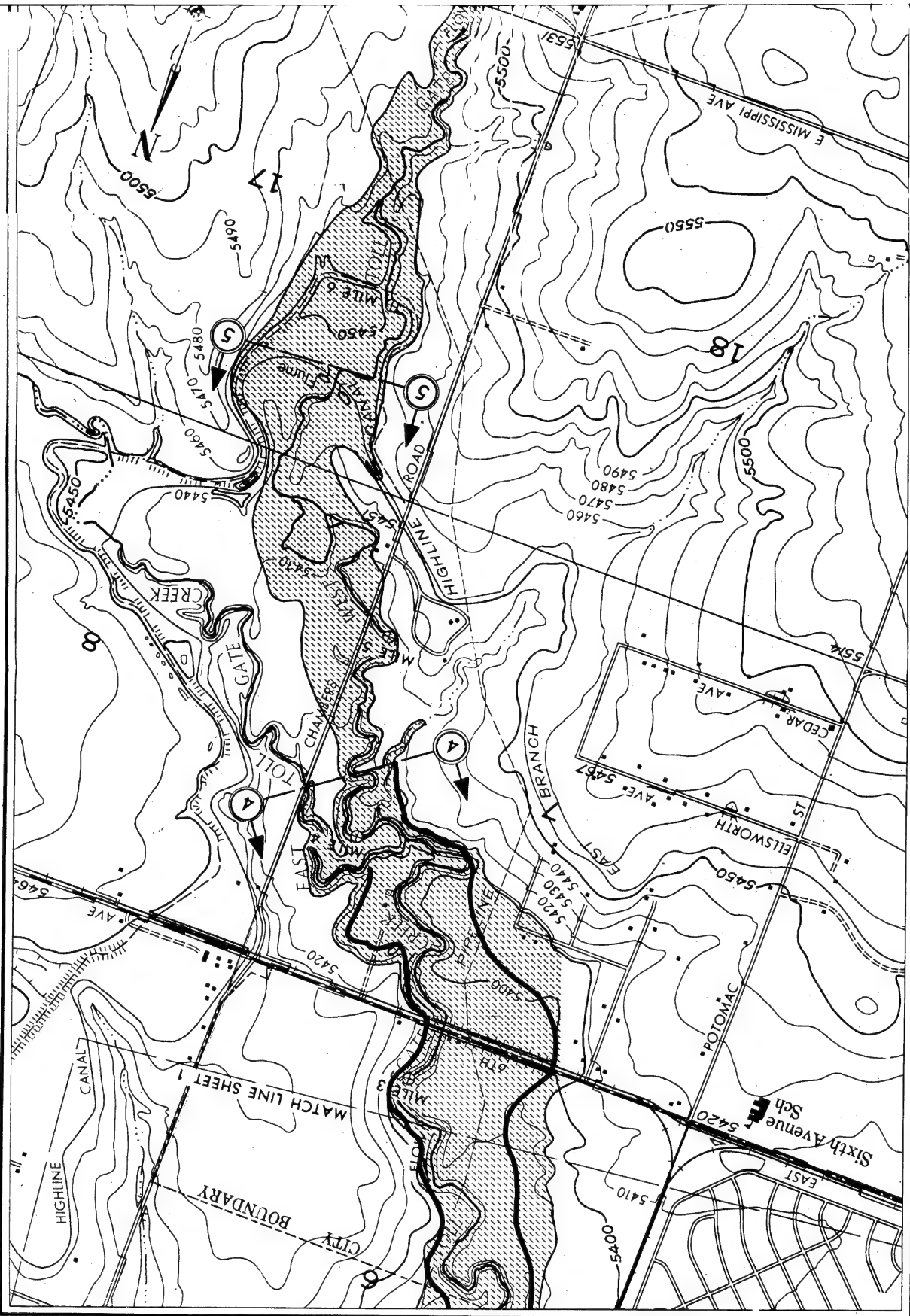
SOUTH PLATTE RIVER BASIN, COLORADO AND NEBRASKA
DENVER METROPOLITAN REGION

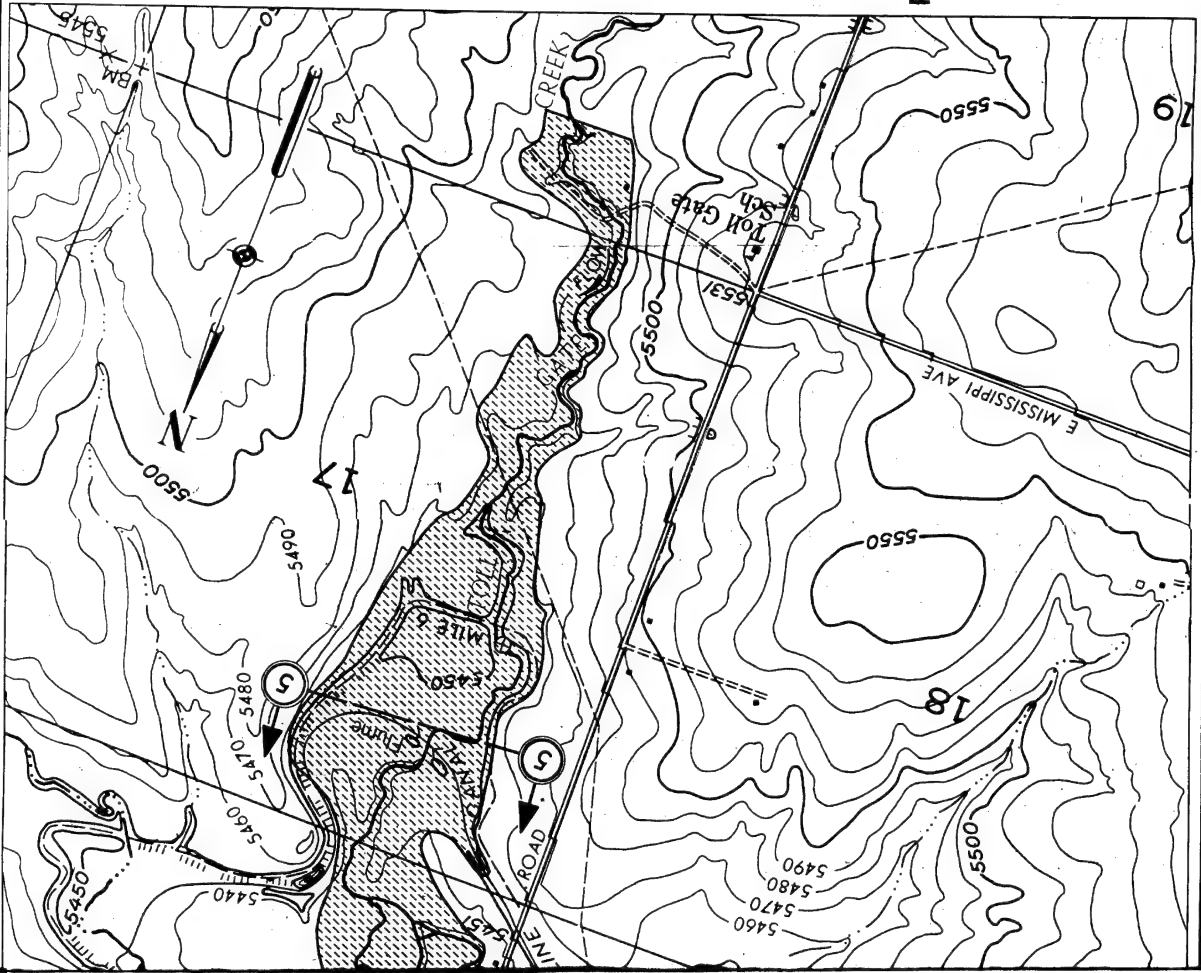
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF TOLL GATE CREEK,
E. MISSISSIPPI AVE. TO MOUTH



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967
SHEET 1 OF 2

CONTOUR INTERVAL 10 FEET





LEGEND

- Area of Indicated Flood Hazard
- 1965 Flood Outline

NOTE:

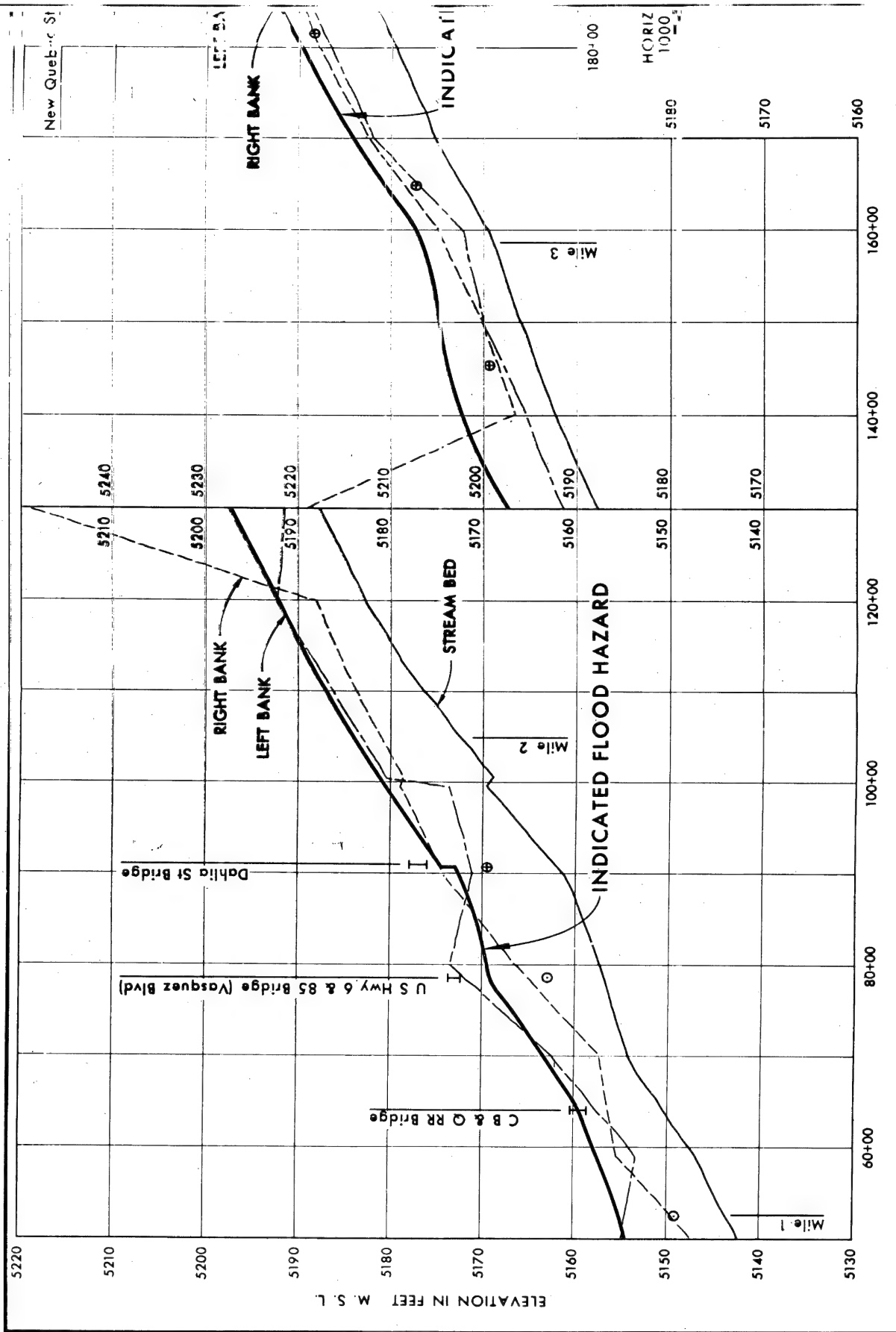
1. See study index map for the location of this sheet. (APPENDIX I PLATE 33)

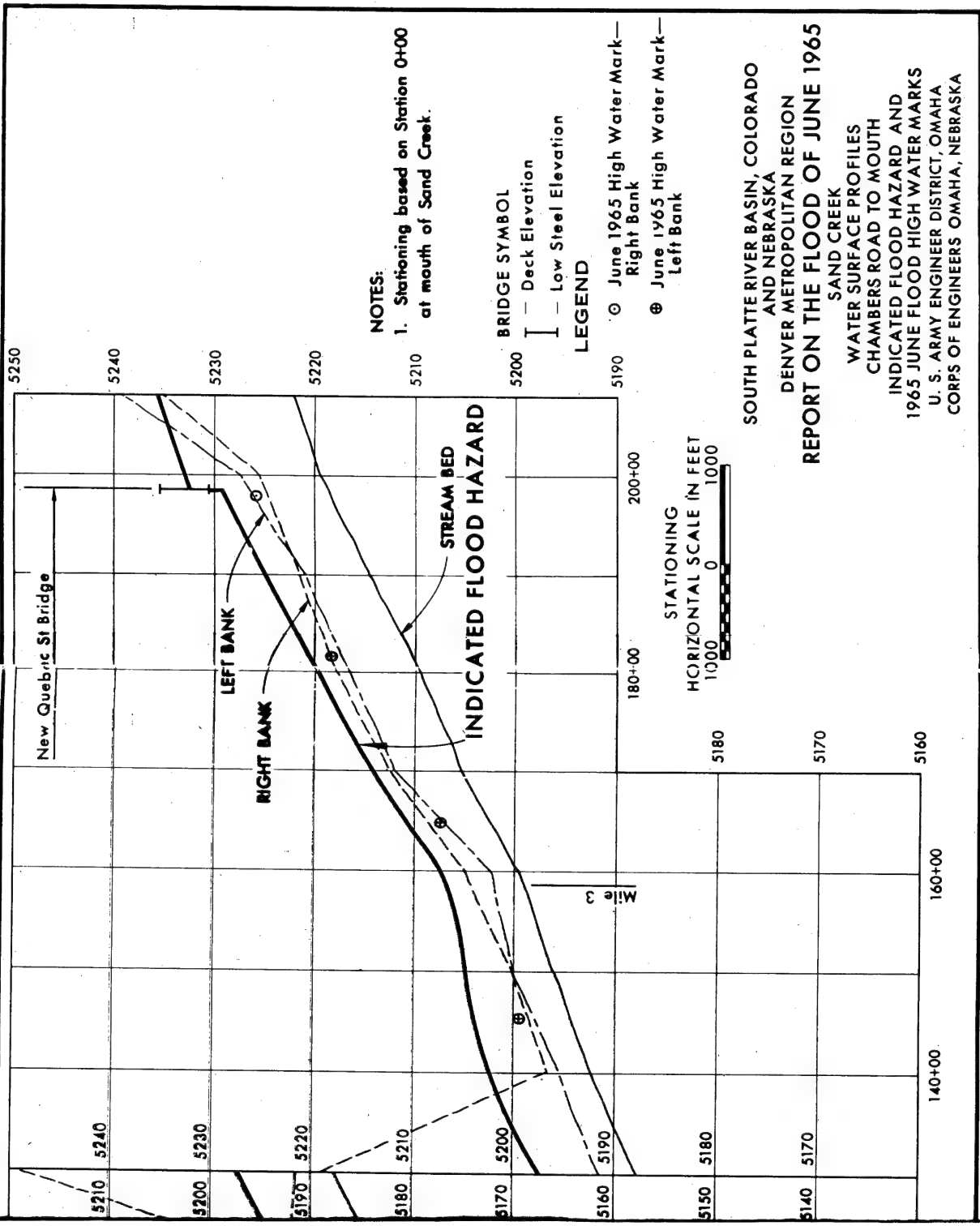
SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
FLOOD OUTLINE OF TOLL GATE CREEK,
E. MISSISSIPPI AVE. TO MOUTH



U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
JANUARY 1967 SHEET 2 OF 2

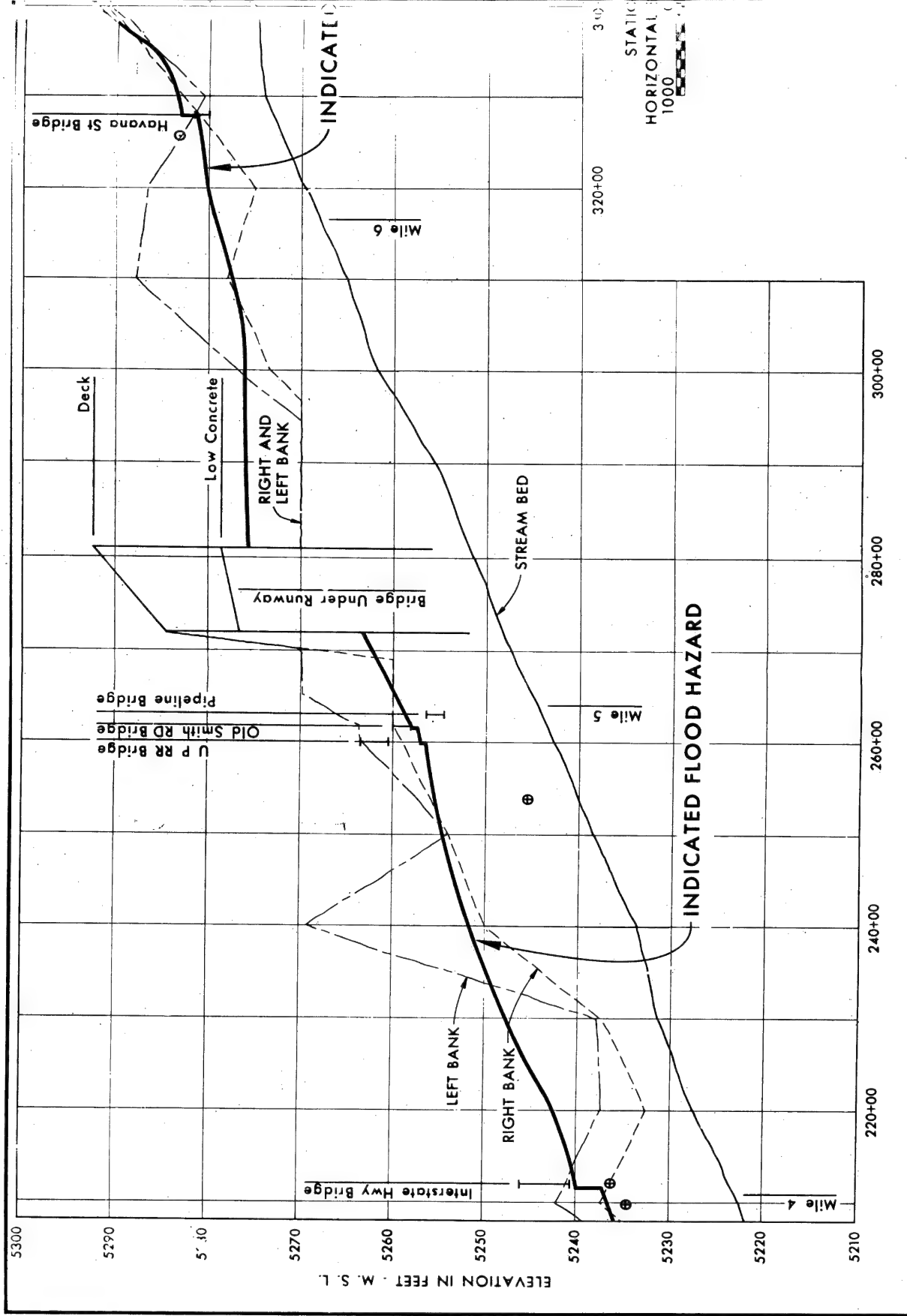
CONTOUR INTERVAL 30 FEET

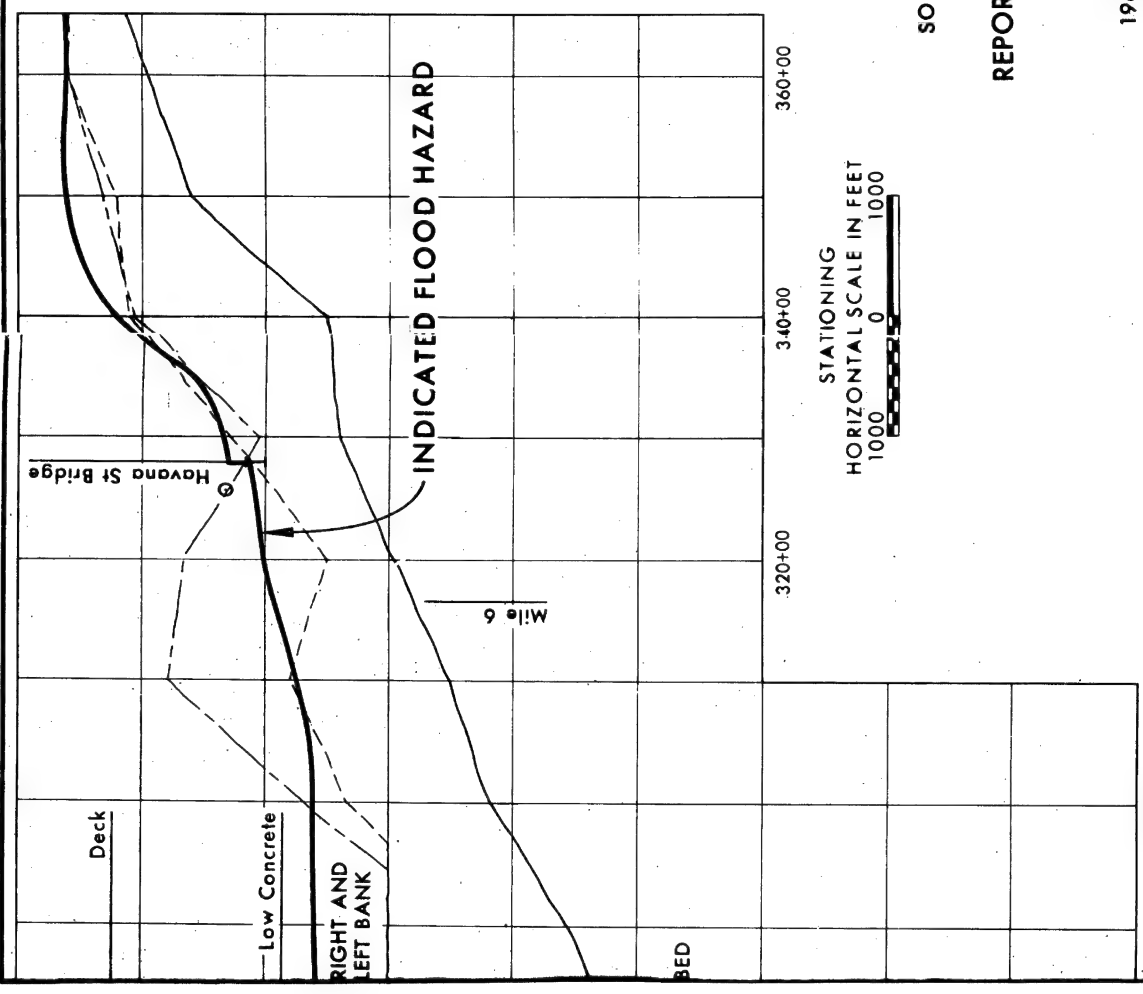




2

SOUTH PLATTER RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SAND CREEK
WATER SURFACE PROFILES
CHAMBERS ROAD TO MOUTH
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

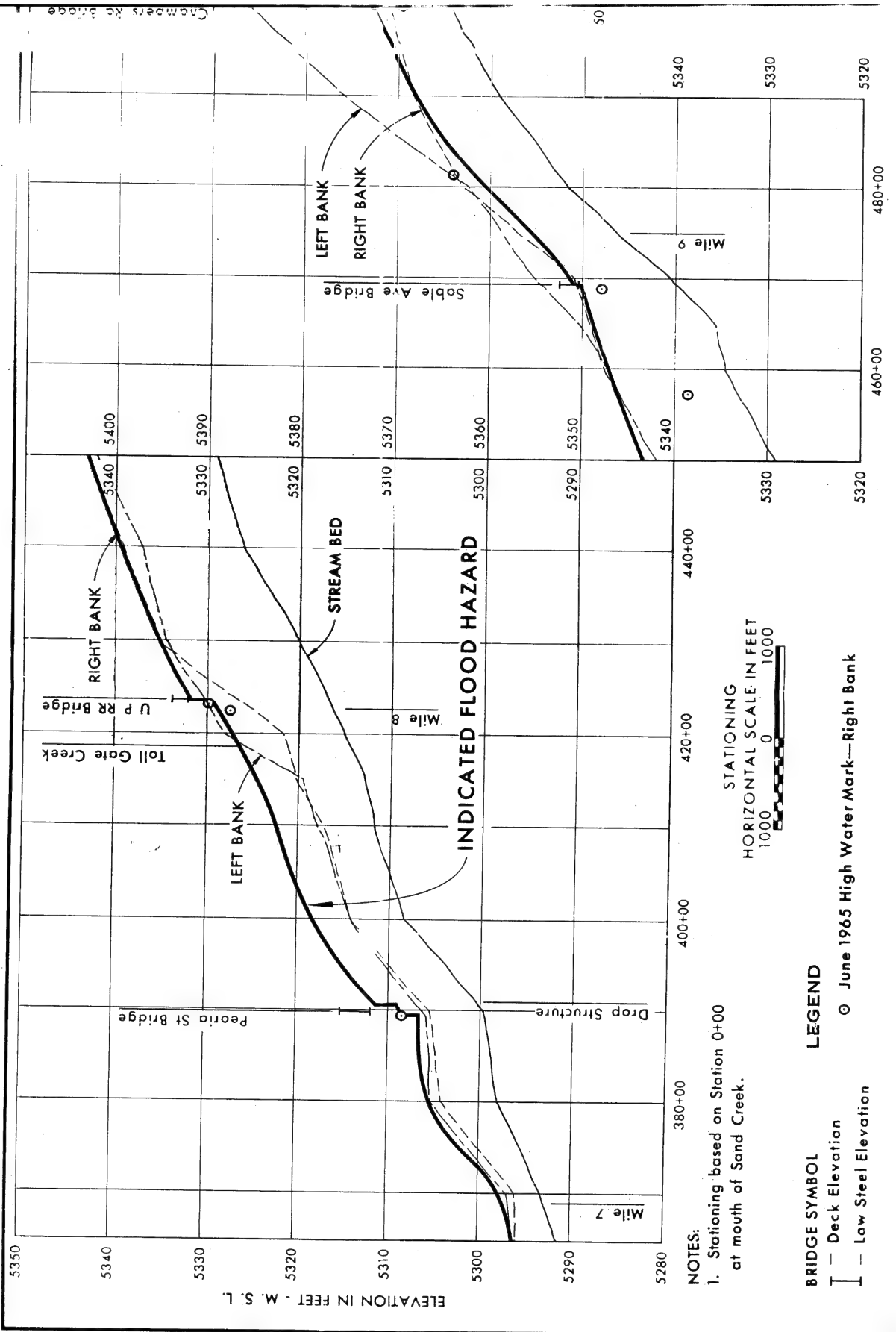


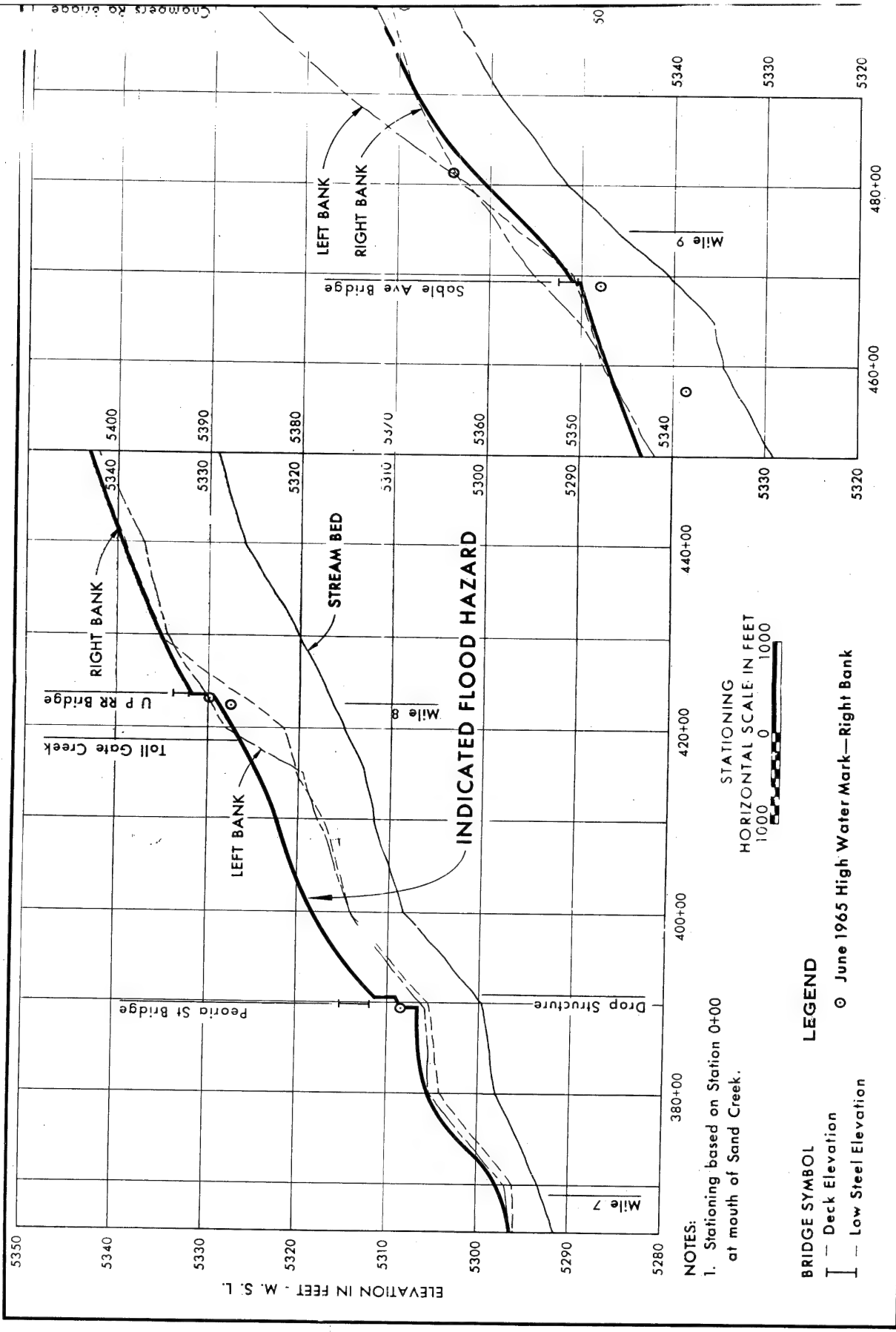


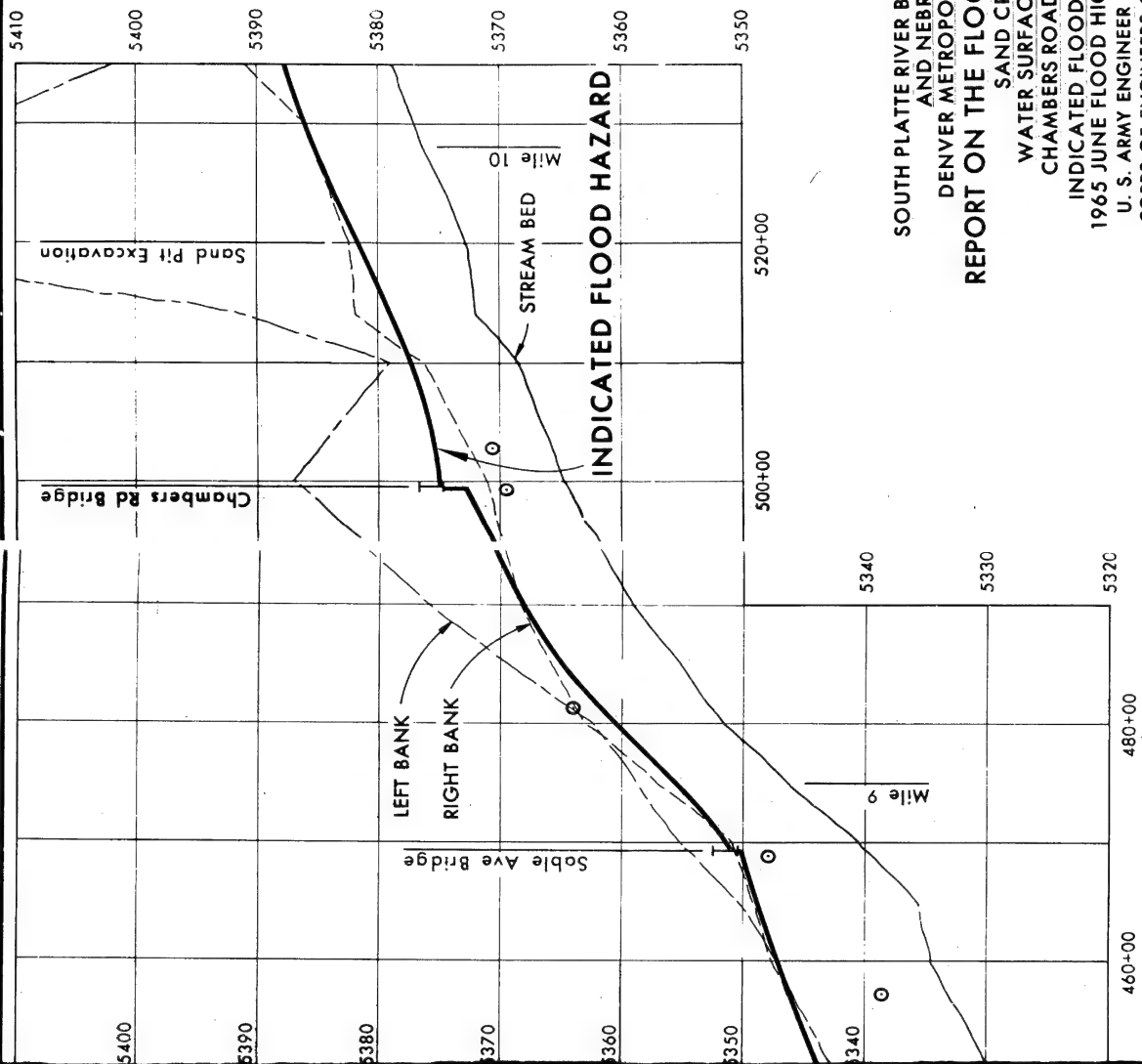
NOTES:
1. Stationing based on Station 0+00
at mouth of Sand Creek.

BRIDGE SYMBOL
— Deck Elevation
— Low Steel Elevation
LEGEND
○ June 1965 High Water Mark—
Right Bank
⊕ June 1965 High Water Mark—
Left Bank

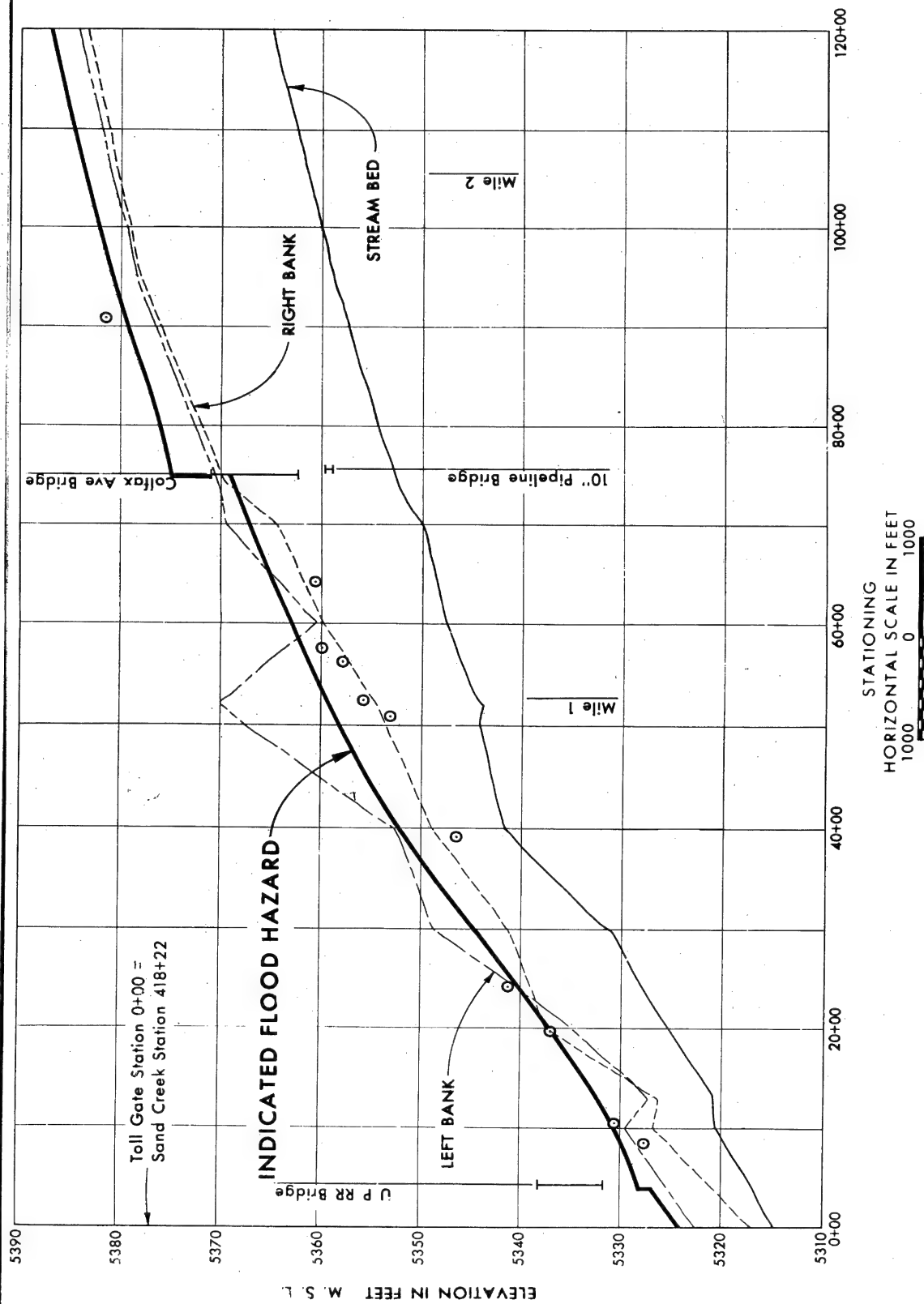
SOUTH PLATTER RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SAND CREEK
WATER SURFACE PROFILES
CHAMBERS ROAD TO MOUTH
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA

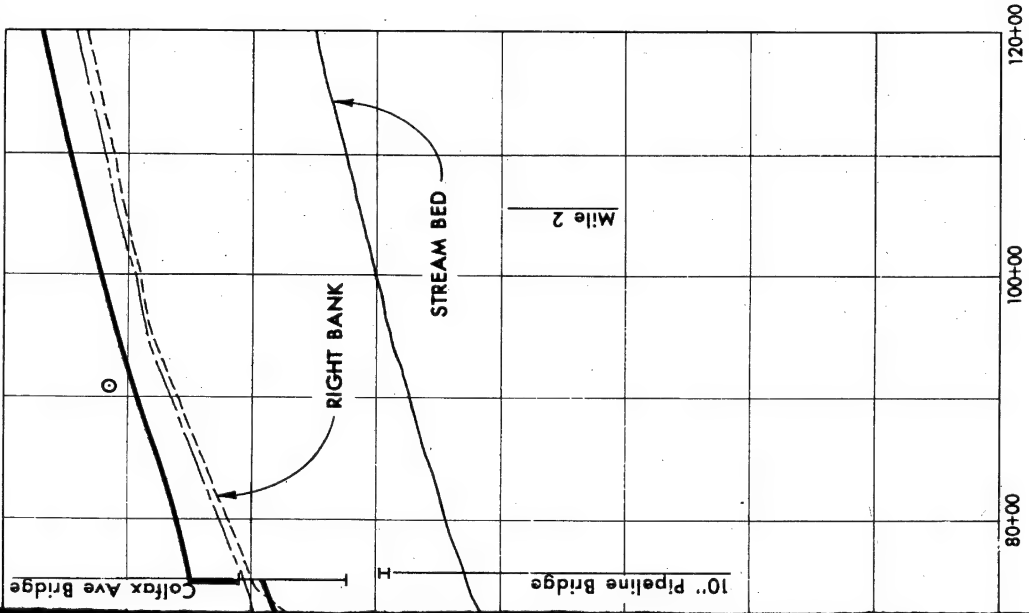






SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA
DENVER METROPOLITAN REGION
REPORT ON THE FLOOD OF JUNE 1965
SAND CREEK
WATER SURFACE PROFILES
CHAMBERS ROAD TO MOUTH
INDICATED FLOOD HAZARD AND
1965 JUNE FLOOD HIGH WATER MARKS
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA





LEGEND

○ June 1965 High Water Mark—Right Bank

NOTES:

1. Stationing based on Station 0+00 at mouth of Toll Gate Creek.

BRIDGE SYMBOL

I — Deck Elevation

I — Low Steel Elevation

SOUTH PLATTE RIVER BASIN, COLORADO
AND NEBRASKA

DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965

TOLL GATE CREEK

WATER SURFACE PROFILES

E. MISSISSIPPI AVE. TO MOUTH

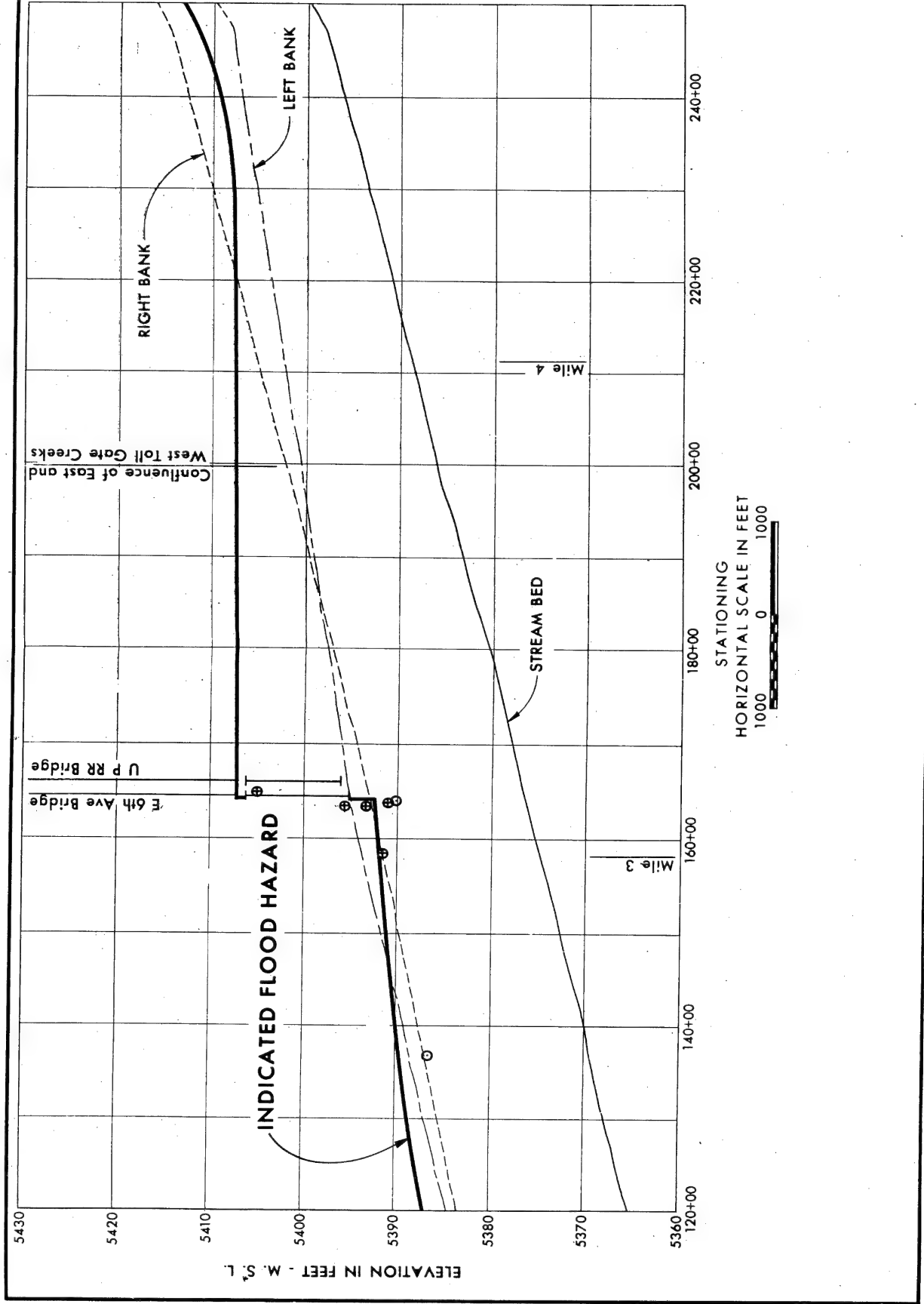
INDICATED FLOOD HAZARD AND

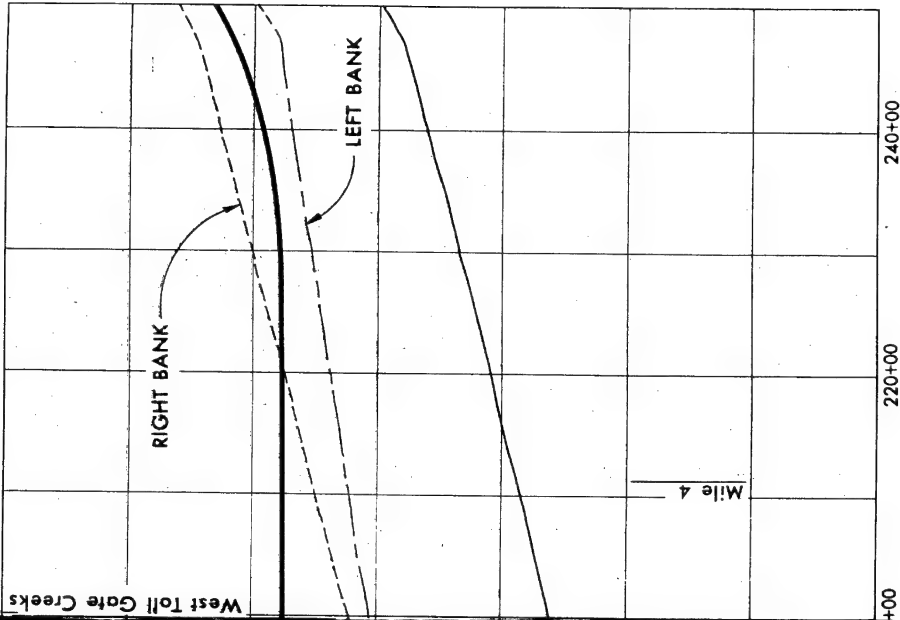
1965 JUNE FLOOD HIGH WATER MARKS

U. S. ARMY ENGINEER DISTRICT, OMAHA

CORPS OF ENGINEERS OMAHA, NEBRASKA

2





LEGEND

- June 1965 High Water Mark—Right Bank
- ⊙ June 1965 High Water Mark—Left Bank

NOTES:

1. Stationing based on Station 0+00 at mouth of Toll Gate Creek.

BRIDGE SYMBOL

- Deck Elevation
- Low Steel Elevation

SOUTH PLATTER RIVER BASIN, COLORADO
AND NEBRASKA

DENVER METROPOLITAN REGION

REPORT ON THE FLOOD OF JUNE 1965

TOLL GATE CREEK

WATER SURFACE PROFILES

E. MISSISSIPPI AVE. TO MOUTH

INDICATED FLOOD HAZARD AND

1965 JUNE FLOOD HIGH WATER MARKS

U. S. ARMY ENGINEER DISTRICT, OMAHA

CORPS OF ENGINEERS OMAHA, NEBRASKA

2



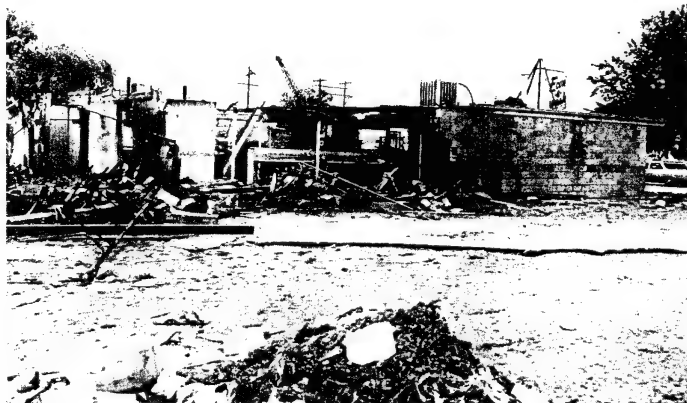
#1 Destruction of highways and bridges due to flooding and bank erosion at Castle Rock on East Plum Creek.



#2 Columbine Country Club area in southern part of metropolitan Denver. Two homes were washed from foundations shown in foreground and house shown was extensively damaged. Rear walls were destroyed and furniture was carried away. Note highwater mark on house.



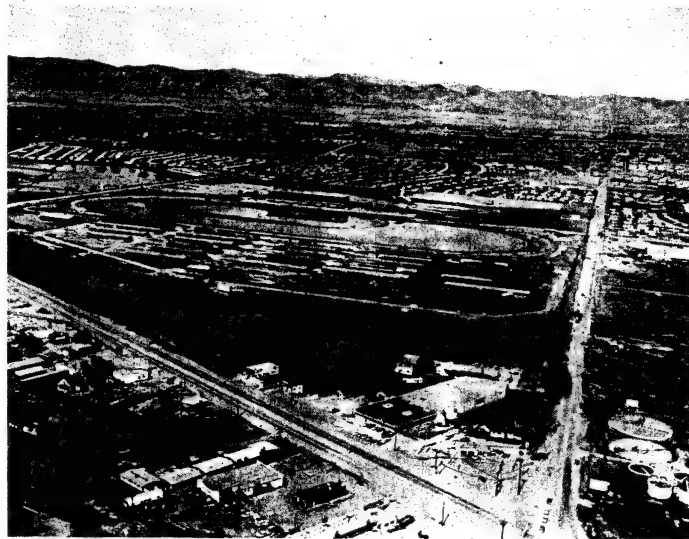
#3 Aerial view of damage and destruction in Littleton area of metropolitan Denver upstream of Bowles Ave. Foundations of destroyed homes can be seen in upper left part and damaged laundramat shown in photograph #4 can be seen in upper right part of photograph.



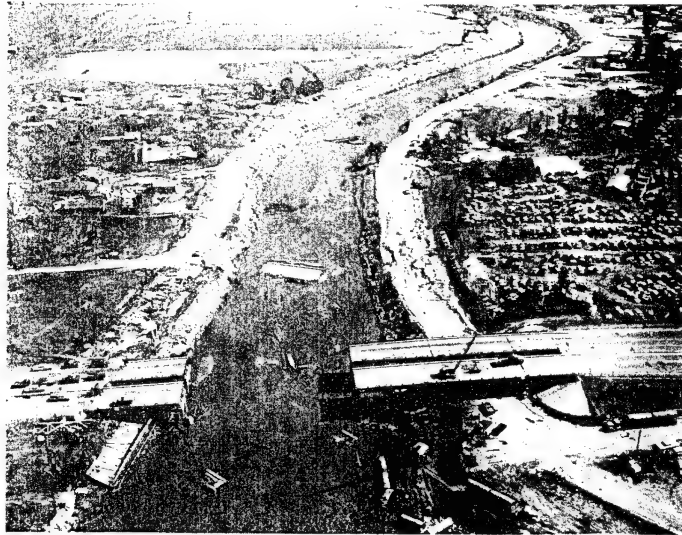
#4 New laundramat at Bowles Avenue in Littleton was demolished by floodwaters and then further damaged by fire.



#5 Destructive force of flood is shown by house and yard damage at Bowles Avenue in Littleton area of south metropolitan Denver.



#6 General view of Centennial Race Track in southern metropolitan Denver showing remains of horse barns. Several barns were completely washed away and only 5 escaped structural damage. Several race horses were swept away with the barns.



#7 Aerial view of damage at Hampden Avenue bridge at south city limits of Denver proper. Old span is shown lodged against left abutment of new bridge and part of new span is shown downstream in channel bed.



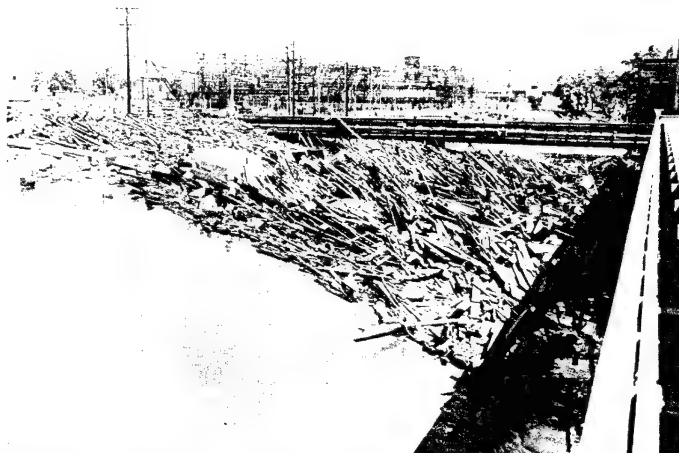
#8 View showing extent of damage in industrial area located north of Mississippi Avenue in Denver proper.



#9 View of house washed from foundation and left on top of cars upstream of Alameda Avenue in Denver proper. Note highwater mark on house.



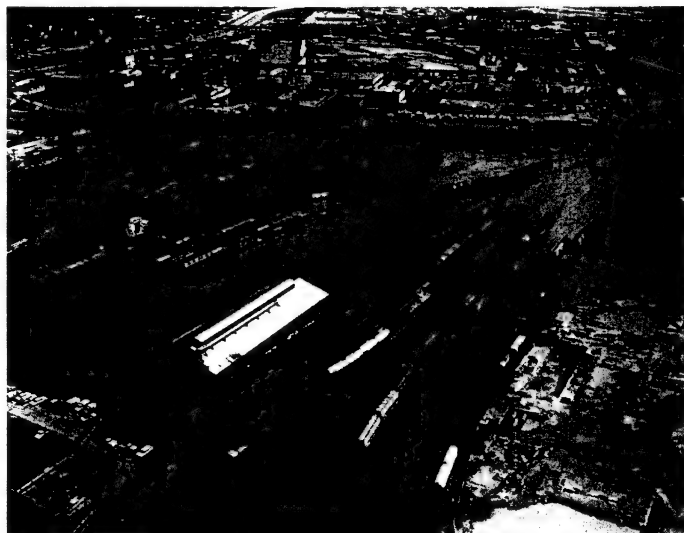
#10 View of damage and debris left in the vicinity of Byers Place, downstream of Alameda Avenue in Denver proper.



#11 View of debris lodged at 13th Avenue bridge in Denver proper. Truck can be seen in center photograph.



#12 Damage and debris at paint warehouse on left bank of South Platte River between 8th and 9th Streets in Denver proper. Note highwater marks on warehouse and over top of cars.



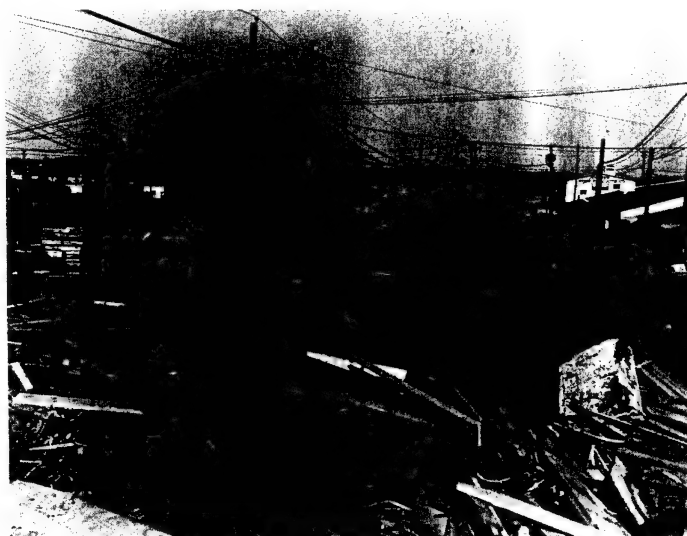
#13 View of flood damage in Colorado and Southern Railroad yards showing cars overturned and askew of tracks. Yards are on right bank across from area shown in photograph #12.



#14 Damage to railroad crossing at north city limits of Denver at Franklin Street. Former location of bridge can be seen at upper part of photo



#15 Extent of bridge road and area flood damage along the South Platte River 4 miles downstream of Fort Morgan, Colorado. Highwater marks can be seen on both banks.



#16 Clearly visible is part of the tons and tons of debris that added to the destruction and despair of the flood.



#17 Aerial view showing receding flood waters of the South Platte River at the south edge of Denver.



#18 The terrific force of the flood is clearly illustrated in this residential area in Littleton.



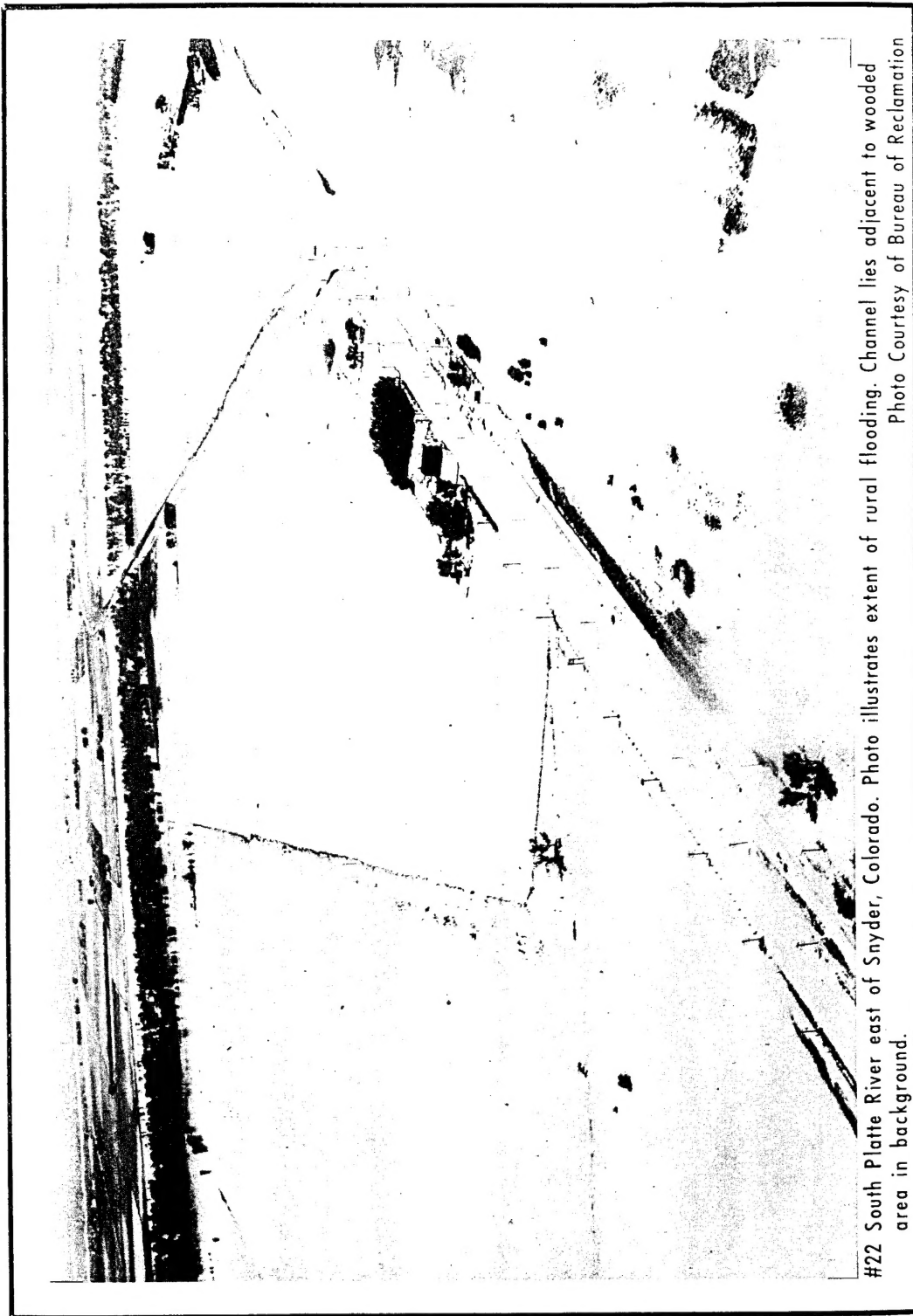
#19 Photo showing section of Littletons' business district in lower left hand corner. The destructive force of the flood is clearly illustrated.



#20 Warehouses and garages damaged by the flood waters. Note high water line at the top of the first story windows on garage in center of photograph.



#21 South Platte River below confluence of Plum Creek. Photo shows evidence of the destructive force which hit the South Platte River Valley.
Photo Courtesy of Bureau of Reclamation



#22 South Platte River east of Snyder, Colorado. Photo illustrates extent of rural flooding. Channel lies adjacent to wooded area in background. Photo Courtesy of Bureau of Reclamation



#23 Photo shows receding and ponded flood waters in the industrial district of metropolitan Denver. Note river stage well below flood stage at this time. Photo Courtesy of Bureau of Reclamation



#24 Receding flood water in metropolitan Denver. View shows freight yard southwest of Speer Blvd. viaduct which was inundated by the flood.

Photo Courtesy of Bureau of Reclamation



#25 Bijou Creek east of Wiggins, Colorado. Note heavy siltation and erosion of highway and railroad grades.

Photo Courtesy of Bureau of Reclamation